AMERICAN MACHINIST

A JOURNAL FOR MACHINISTS, ENGINEERS, FOUNDERS, BOILER MAKERS, PATTERN MAKERS AND BLACKSMITHS.

VOL. 10, No. 12 } WEEKLY. | NEW YORK, MARCH 19, 1887. | { $2.50 per Annum. SINGLE COPIES, 5 CENTS.

COPYRIGHT 1887, BY AMERICAN MACHINIST PUBLISHING COMPANY. For Sale Everywhere by Newsdealers. ENTERED AT POST OFFICE, NEW YORK, AS SECOND CLASS MATTER.

Modern Locomotive Construction.

BY J. G. A. MEYER.

THIRTY-FOURTH PAPER.

LIFTING SHAFT.

Fig. 189 represents an end view and Fig. 190 a plan of the "lifting shaft," or, sometimes called the "reverse shaft." Two arms *B B*—one for each link—are forged to the shaft *D*; the holes for the pins *A A* in the end of these arms are tapered; the taper should be the same as that of the valve rod-pin, see eighteenth paper.

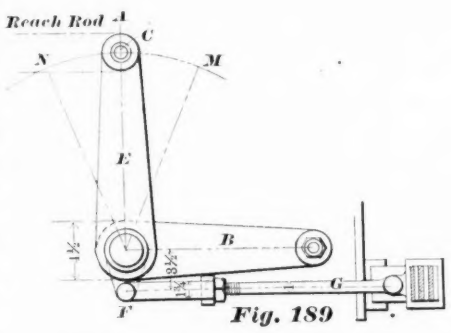


Fig. 189

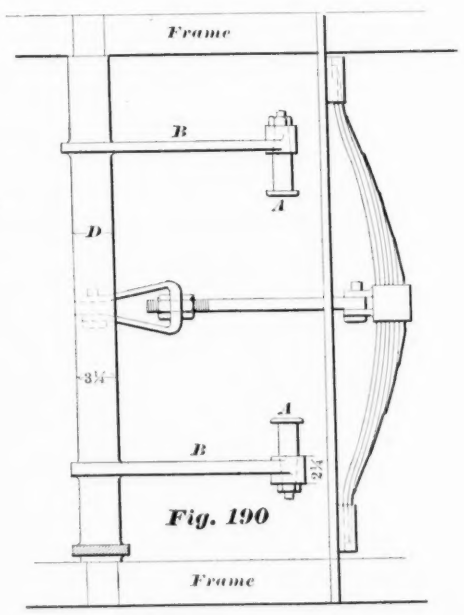


Fig. 190

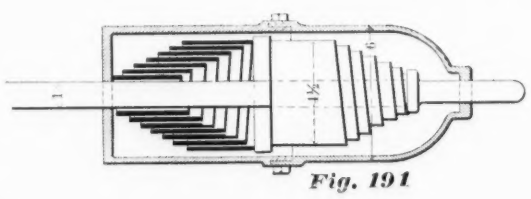


Fig. 191

The case-hardened lifting shaft pins *A A* are made to fit these holes very accurately. On these pins the link hangers vibrate. The arm *E* is generally forged to the shaft *D*; occasionally it is keyed to the shaft. The hole at *C* for the reach rod-pin is bushed with a wrought-iron ferrule case-hardened usually from $\frac{1}{8}$ to $\frac{3}{16}$ of an inch thick. The reach rod-pin, which connects the reach rod to the arm *E*, is straight and case-hardened. The other end of the reach rod is connected to the reversing lever at *C*, as shown in Fig. 192 (page 2). The line *L B* (Fig. 192) represents the center line of the reverse lever when it stands in full gear forward, and the line *A B* represents the center line of the reverse lever when it stands in full gear backward; and when the reverse lever stands in center of the arc as shown, the link motion is said to be in mid-gear. Now when the reverse lever (which is connected by the reach-rod to the lifting shaft) is moved from *A* to *L* the motion of the engine will be reversed; or if the reverse lever is moved to any intermediate position the travel of the valve will be reduced, and steam in the cylinder cut off sooner.

The diameter of the lifting shaft (Figs. 189 and 190) and the size of its arms must be sufficiently large to prevent the shaft and arms from springing. The dimensions given in the figures are those of lifting shafts generally used in locomotives which have cylinders 20 inches in diameter. For smaller locomotives, which have cylinders 10 inches in diameter, the lifting shaft arms *B B* close to the shaft are usually 2½ inches wide and $\frac{5}{8}$ of an inch thick; the arm *E* is 2½ inches wide and $\frac{3}{4}$ of an inch thick; and the shaft 2 inches in diameter. These dimensions are gradually enlarged as the diameter of the cylinder is increased.

The location of the lifting shaft and the length of its arms *B B* will influence the equalization of the cut-off: therefore, it is very important to assign the correct position to the lifting shaft and make the arms *B B* to the proper length. How to find the position of the lifting shaft and the correct length of the arms *B B* is explained in the fourth paper on "Laying out Link Motion," AMERICAN MACHINIST, page 6, May 31, 1884. The length of the arm *E* is generally limited by the design of the locomotive; that is, the length of this arm must be such as will prevent the reach rod from coming in contact with other parts of the engine.

The center lines of the arms *B B*, and that of the arm *E*, do not often stand at right angles to each other as shown: they should have following relative positions: The center line *H D* of the arm *E* should stand perpendicular to the reach rod when the link motion is in mid-gear; and the center lines of the arms *B B* should then stand in the center of their total vibration. This will allow the end of the arm *E* to pass through equal arcs on each side of the line *H D* during the time the links are moved from full gear forward to full gear backward. The short arm *F* is usually forged to the shaft *D*; occasionally it is bolted to the shaft. To this arm *F* a spring counterbalance is attached which acts against the weight of links, hangers, etc., and thus relieving the engineer of considerable hard work in reversing the engine and enabling him to move the reverse lever as easily in one direction as in the other. Sometimes, for the purpose of counterbalancing the weight of the links, hangers, etc., volute springs are used as shown in Fig. 191, but the writer believes that half elliptic springs, as shown in Figs. 189 and 190, will give better satisfaction.

Volute springs, as shown in Fig. 191, are made of steel 3 inches wide, $\frac{5}{16}$ of an inch thick, and about 6 to 6½ inches long for large locomotives. For small locomotives these springs are made of steel 3 inches wide, $\frac{1}{4}$ of an inch thick, and the same length as that of the larger ones.

Elliptic springs are usually made nearly as long as the space between the frames will allow. For large engines, 4′ 8½″ gauge, the length of these springs is usually 40 inches before compression, and having 5 or 6 leaves of steel 2½ inches wide and $\frac{5}{16}$ thick.

When these half elliptic springs are used, the rod *G* (Fig. 189) should be attached to the arm *F* in a manner as shown, which will allow the spring to be tightened or loosened without disconnecting the rod *G* from the spring.

Reach rods for large locomotives are usually made of 2¾″ x ¾″ iron; and for smaller locomotives 2″ x $\frac{5}{8}$ iron.

REVERSE LEVER.

The design of an engine and the position of its driving wheels determines the location of the reverse lever. Generally, in engines having a foot-plate the lever can be attached to the same: in consolidation engines or hard coal burners we are generally compelled to attach the lever to the frame. In all cases, the reverse lever is located on the right hand side of the engine. The reverse lever is usually made of wrought-iron; but when the part of the lever below the arc *D*, Fig. 193, is very crooked—which often occurs—then in order to save labor in forging, the lower part is sometimes made of cast-iron and bolted to the upper part, which is made of wrought-iron. The form of the lower end of the reverse lever is determined also by the design of the engine. In consolidation engines it often happens that the reverse lever has to move between one of the rear driving wheels and the boiler, and therefore its lower part has to be made comparatively thin and very wide, as shown in Fig. 192. In engines which have the reverse lever attached to the foot-board, the lower end of the lever is shaped as shown in Fig. 193, and its thickness the same throughout; usually $\frac{3}{4}$ of an inch for large engines, and $\frac{5}{8}$ of an inch for smaller locomotives.

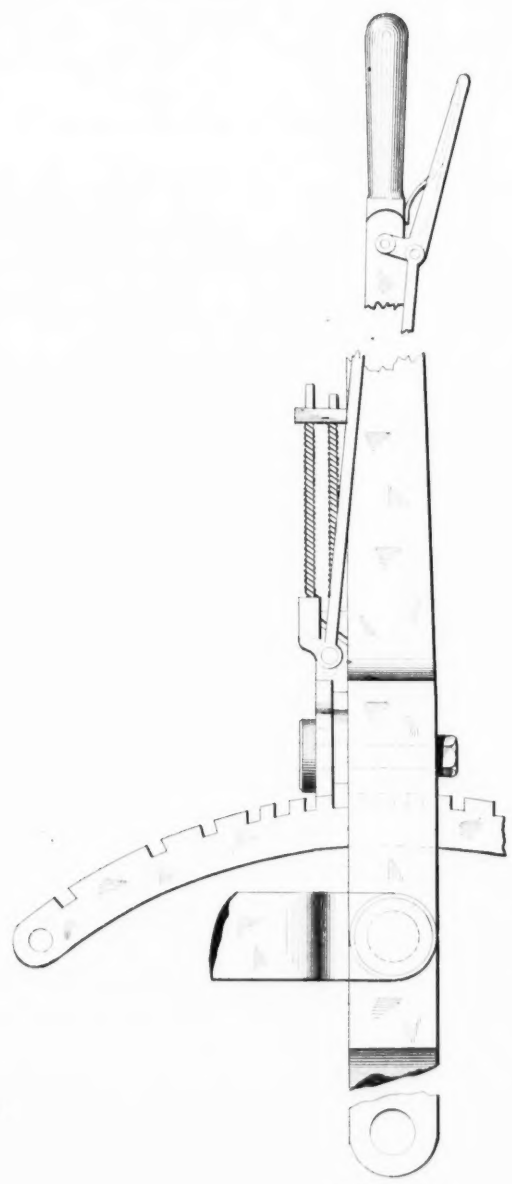


Fig. 195

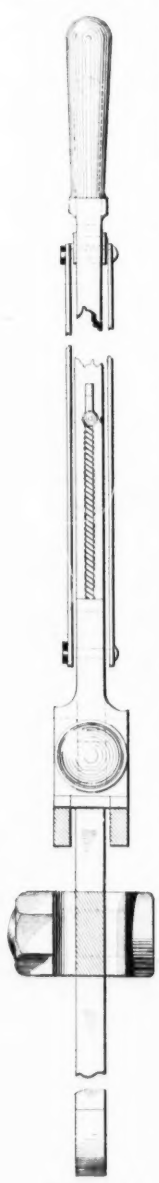


Fig. 196

The total length of the reverse lever and the location of the reach rod-pin in the same must be such as will allow the top of the reverse lever handle *O*, Fig. 192, to move through a distance of about 4 feet in large engines; and through a distance of about 3 feet 6 inches in smaller engines during the time that the link is moved from full gear forward to full gear backward. Now, since this distance through which the link is moved is equal to the distance between the centers of eccentric rod-pins, and since these are placed from 11 to 12 inches apart in large engines, and from 9 to 10 inches in small engines (see thirty-third paper) we may say that the distance through which the reverse lever handle moves should be about four times the distance through which the link moves.

The diameter of the reverse lever pin *B*, Fig. 192, is usually 1 inch for small locomotives and 1¼ inches for large engines. These pins are case-hardened.

The hole *C* for the reach rod pin in the reverse lever is sometimes bushed with a case-hardened ferrule.

The arcs *D* are usually made of steel, fastened to the boiler, or to the foot-plate and running board. In a number of engines two arcs are employed, one on each side of the lever, as shown in Fig. 192. In other locomotives one arc only is used, which passes through an opening in the reverse lever as shown in Fig. 194. When a single arc is used it is made comparatively wide, as will be seen by comparing Fig. 192 with Fig. 194. Whether to use two arcs or the single arc is a matter of choice and judgment. The arcs should be placed as high as the design of engine will permit; by so doing more notches *F F* can be cut in the arcs with sufficient metal for strength between them, than can be cut in arcs placed lower down. The notches *F F* receive the latch *G*. This latch is connected to the latch-handle *H* by the links *I*, so that, when the latch-handle is pressed towards the handle of the reverse lever, the latch *G* will be lifted out of the notch, and when the pressure on the latch-handle ceases, the spring *K* presses the latch into the notch. With this arrangement the lever can be placed and held in any desirable position. The writer believes that it will give better satisfaction by placing the latch *G* (which slides in the clamp *M*) in front of the reverse lever, as shown in Fig. 192, and not in the rear of the reverse lever, as shown in Fig. 193. By adopting the former method the reverse lever will press against the latch; but by placing the latch in the rear of the lever, the tendency will be to pull the reverse lever away from the latch, which will in a short time cause the lever to rattle and interfere with the delicate action of the link motion.

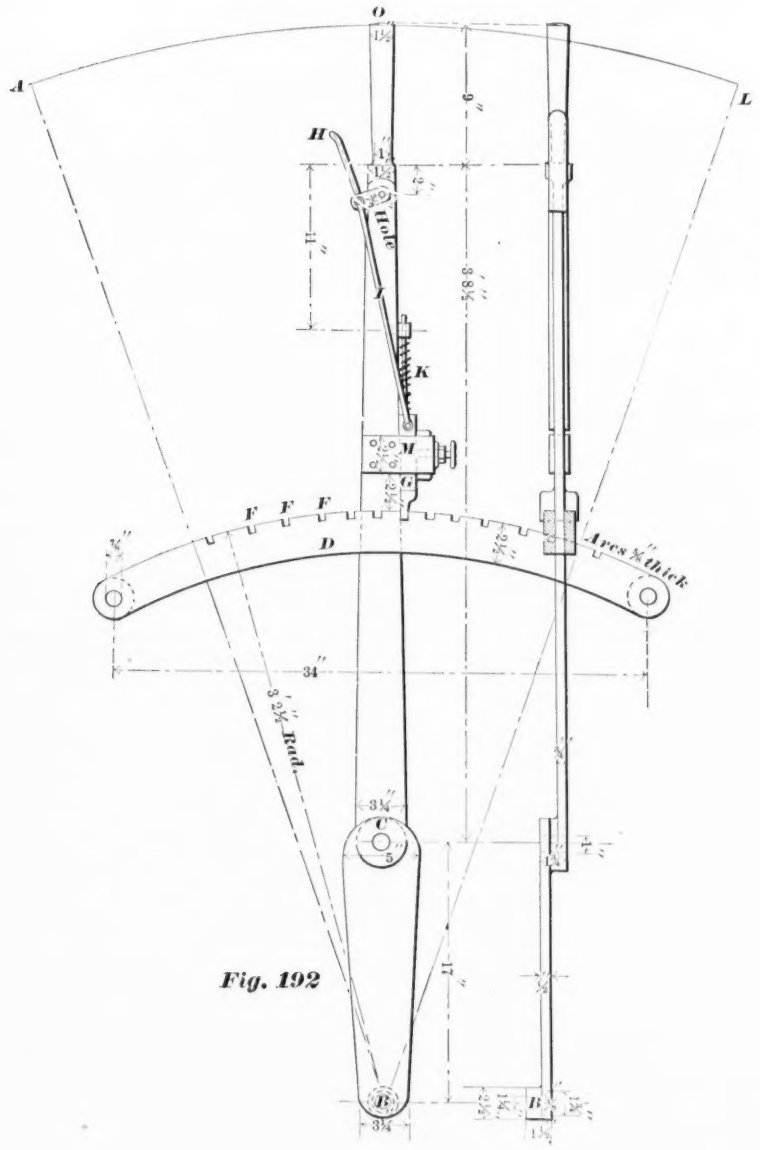


Fig. 192

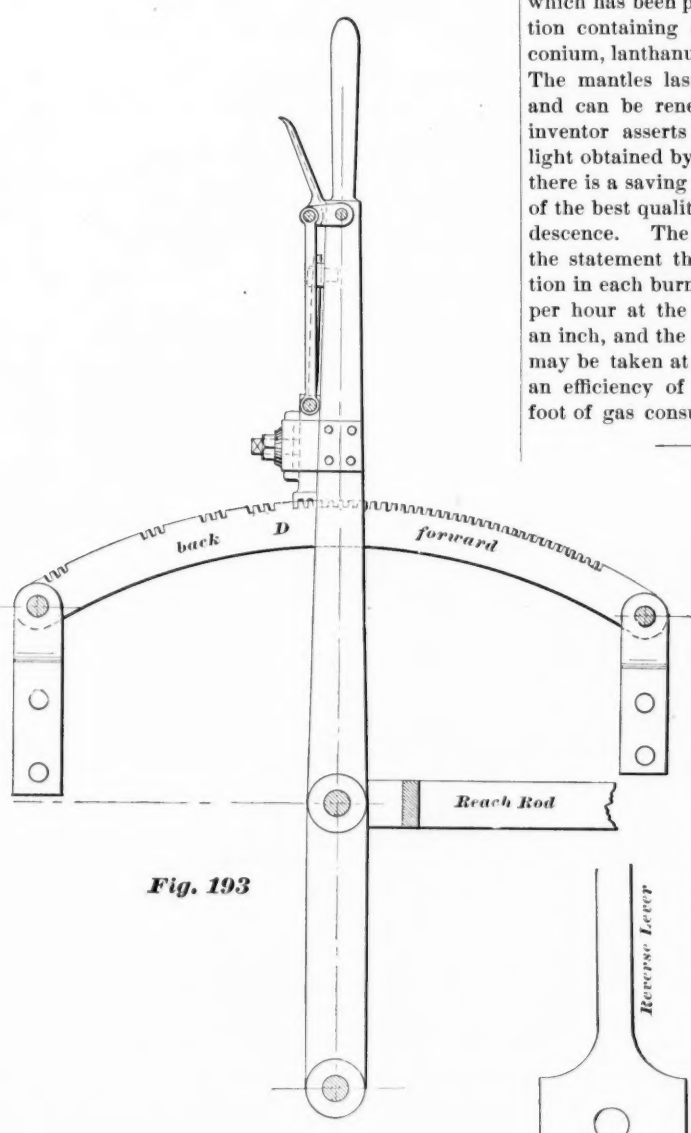


Fig. 193

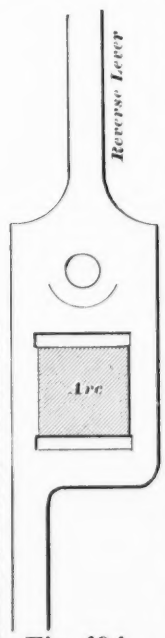


Fig. 194

Master mechanics differ in opinion in regard to the number and the position of the notches in the arcs. First: A number of master mechanics prefer the notches arranged in a manner which will hold the reverse lever in positions which will cause the steam to be cut off in the cylinder at some full number of inches of the stroke. Consequently, we find arcs with notches cut in such positions as will cause the steam to be cut off at 6, 9, 12, 15, 18, and 21 inches of the stroke; or at 6, 8, 10, 12, 15, 18 and 21inches of the stroke. Besides these notches one notch is cut in the arcs to hold the link in mid-gear. With this arrangement of notches a difficulty arises, namely, it is often found that when a particular notch—say the 6 inch notch—holds the reverse lever, the cylinders do not receive a sufficient amount of steam to haul the train, and when the reverse lever is moved to the next notch—the 9 inch notch—the cylinders receive too much steam, and therefore the steam has to be throttled, causing the locomotive to work under disadvantages. To overcome this difficulty, May's Reverse Lever Latch has been invented, by which a finer gradation is obtained without changing the notches. This latch is shown in Figs. 195 and 196, and, as will be seen, is a very simple device. The only difference between this and the ordinary latch is, that the former is a double latch instead of a single one; consequently, it can easily be applied to the reverse levers at present in use without any change in the levers or arcs. Now, since a finer gradation is not a matter of convenience, but it is a saving of fuel, the advantages of May's latch, or some equally good device, will easily be perceived.

But while some master mechanics will insist on having the notches cut in the foregoing manner, others believe that whether steam is cut off at full inches, or fractional number of inches of the stroke, is of no consequence, hence these master mechanics will cut as many notches in the arc as there is room for, and as close together as the strength of metal will allow. Fig. 193 shows an arc with notches cut in this manner. The distance between the centers of these notches is half an inch; sometimes the notches are cut closer than this. With notches cut in this manner a very fine gradation of cut-off is obtained, and fuel saved.

The local inspectors of steam vessels in New York harbor find that about 70 tugs are carrying more steam than the law allows. The penalty is a fine of $500 and imprisonment for two years.

Mechanical Work at Purdue University.

Prof. W. F. M. Goss, of Purdue University, writes us:

"Purdue University is the Indiana Agricultural and Mechanical College. It is endowed by the General Government and by John Purdue, from whom it takes its name.

"Mechanical Hall, a floor plan of which is presented herewith, was erected in 1885 for the purpose of affording students accommodations necessary to a course of shop practice. The workshop is 33′ × 80′, and is fitted with twenty benches, ten 3′ lathes, one 9′ lathe, a circular saw, a scroll saw and a grindstone. The foundry, 33′ × 35′, is equipped with a cupola furnace, a crucible furnace and a core oven; there are sixteen places for bench moulding. The forge shop, 33′ × 35′, accommodates sixteen forges. In the machine shop, which is 33′ × 40′, are four 14″ Prentice lathes, one 10″ and one 16″ Reed lathe, one 16″ Atlas lathe, a Pond planer, a Gould & Eberhardt shaper, a Brown & Sharpe milling machine, an Atlas drill, a Slate sensitive drill, a speed lathe, an emery grinder and a grindstone.

"The course of practice is arranged as follows: 1. Elementary bench work and turning. 2. Pattern making and foundry work. 3. Vise work. 4. Iron and steel forging. 5. Machine work.

"Mechanical drawing accompanies the shop work throughout the course, and explanatory lectures are given whenever they seem desirable. For example, the requirements of a given class of patterns are discussed in the class-room. From a drawing of a finished casting the student is required to develop whatever may be necessary in the line of pattern work to secure the casting. The drawing thus made is used in the shops as a working drawing of the pattern, etc.

"About a hundred students working in six sections two hours per day are now availing themselves of shop privileges."

Some women are turning their attention to architecture. There seems to be no reason why women would not make good architects. Their domestic tastes ought to lead them to design acceptable dwelling houses.

A New Gas Light.

Experiments were made last night at the Marlborough Gallery, Pall Mall, with a new system of gas lighting invented by Dr. Von Weisbach, of Vienna. The picture gallery, which belongs to Mr. Colnaghi, was lit by some small lamps, containing apparently an electric light, similar to that used at the Savoy Theater. In reality, however, the light employed was that of ordinary gas raised to a point of incandescence by a process which the Viennese inventor has patented. There could be no doubt as to its superiority over the ordinary light in bringing out all the details of the pictures on the walls, and should the expectations formed of it be realized it will successfully rival electricity as an illuminant of power and brilliancy, for which the latter has so long been pre-eminent.

The official description states that the light is produced by "placing within the flame of an atmospheric or Bunsen burner a mantle or hood of cotton net or webbing which has been previously steeped in a solution containing oxides of the elements zirconium, lanthanum, and some other bodies." The mantles last from 800 to 2,000 hours, and can be renewed at a small cost. The inventor asserts that not only is a better light obtained by using his burner, but that there is a saving of gas, which need not be of the best quality for the purposes of incandescence. The description concludes with the statement that the "average consumption in each burner is about two feet of gas per hour at the pressure of nine-tenths of an inch, and the average illuminating power may be taken at about 17 candles, showing an efficiency of about 8½ candles per cubic foot of gas consumed."—*London Telegraph.*

Some Notes on Steel.

By John Coffin.

The tempering of forged tools is a very important matter, as it has a direct influence on the profits of the shops, even more on account of the cutting speed than on that of the durability of the tool and the cost of its renewal. A good tool will cut faster, save time in grinding and setting, and, in many instances, save the time of the workman that would be spent in waiting for the smith to forge and temper a new one.

In shops where a regular tool dresser is employed, who does nothing but forge and temper tools, the trouble with poor tools is comparatively slight, because the skill and knowledge acquired by long practice make him expert in turning out good work; but in the majority of shops there is no regular tool dresser, and in some of the small ones every workman makes his own tools (or some of them at least) while in others the boss or one or two of the most expert workmen forge the tools for the whole force. This last may be a good plan in a small shop, and in many cases it is the only feasible one, but the question, "How large must a shop be in order to warrant the hiring of an expert tool dresser?" is one for the manager to decide. I would, however, advise that one should be employed as soon as there is work enough, in forging, to keep a smith busy half of the time, and moreover he should be a good tool dresser, regardless of wages, for an expert tool dresser will make a fair forge hand; it costs too much to train a horseshoer to make good shop tools.

Most machinists and blacksmiths think they know something about tempering, but on this, as on other subjects, those who know the least think there is least to know. Hoping that some will be benfited who lack experience, and trusting to the kindly criticism of the experts, I present the following general rules for tempering forged tools:

It is presumed you have forged your tool in a clean fire, and have let it cool down till it shows very little, if any, red in the light of the shop, and thus you start with a clean fire and a cool tool.

1st. Heat slowly and evenly until the "hardening temperature" is reached; 2d. Do not surpass the "hardening temperature"; 3d. Do not let a tool soak long in the fire after the "hardening temperature" is attained.

These are inflexible rules for the tempering of all tools made of carbon steel, and they need not be modified in the least for the ordinary forged shop tools.

There are three questions that naturally present themselves, viz.: "What is the 'hardening temperature'?" "How are we to know when it is reached?" And, finally, "As the degree of hardness varies with the temperature, how are we to know what degree of hardness determines the 'hardening temperature'?"

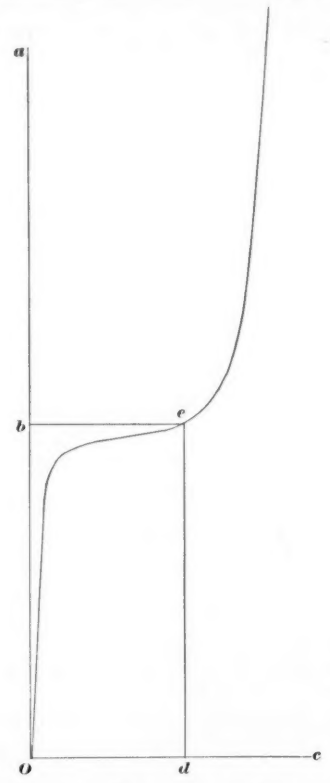
The answers to these questions can only be determined by experiment with the steel in use, but to enable any one to make these experiments readily, I append this sketch, in which the irregular curve is the curve of hardness: The distance of any point of the curve above the line *O c* represents the temperature, and its distance to the right of the line *O a*, the hardness after heating to this temperature and cooling suddenly in water. The curve has not been plotted from actual determinations, but is drawn to show the general character of the curve of hardness.

This curve would not coincide with the curve of hardening carbon, because some of the hardness is due to molecular tension, as Mr. Metcalf has shown. The general character of the curves would be the same, the greatest departure being at the extreme lower end. The "hardening temperature" is the temperature before which the greatest change of carbon occurs with the least increase of temperature, and as, at this point, our hardness curve nearly or quite coincides with the hardening carbon curve, it will be seen that this point is at *e*, or where the curve changes direction.

The temperature varies with the different qualities of steel, and seems to be more affected by the varying amount of the other chemical constituents than by the amount of carbon. For the ordinary grades of tool steel I should advise heating to a fire-red in the dark, or to about the shade of red seen in the stripes of the American flag. This will be a very much lower temperature than you will suppose till you try it by holding the tool in a dark place. I do not like the term "cherry red," since cherries vary in shade from white to black.

The temper can be drawn on most forged tools by the heat contained in the body of the tool, and, remembering this, let us consider such a tool under treatment, although this is not intended as a treatise on tools. Let us suppose the tool to be a diamond point for the lathe or planer. Such a tool should be forged so that there shall be considerable available tool, that is, so it will bear considerable grinding without re-forging, and it should be so tempered as to be as good steel in one place as another.

Be sure you do not heat too high; the greatest danger lies in this direction. Heat evenly the whole forged part of the tool, letting the heat grade down the unforged part, and after it is properly heated dip the entire forged part in water; not the end, but the edge of the forged part first, since you are then more certain to get all of the front edge under water without allowing some



CURVE OF HARDNESS OF STEEL.

portion of it to become partially cooled by conduction, and finally all this must be done without immersing any of the shank.

Take plenty of time, do nothing hurriedly, remember that when once steel is heated to the "hardening temperature" it retains its hardening properties, even though it cools somewhat. Understand, I do not advocate cooling it any before putting in water, for this is more or less injurious, but there is no need for the extreme haste exhibited by some people in tempering.

After putting the tool in water wait until the forged part is cold and the shank has cooled down somewhat; the amount of cooling necessary can only be determined by experience. Then remove from the water and try with a file to see if it is hard enough, if you do not know the steel, or if you are not an experienced temperer. If it is hard your heat has been sufficiently high.

Then brighten one side somewhat on a piece of grindstone, which is very good for this purpose, remembering that there is still no hurry; wait until a slight straw color shows itself evenly over the whole surface of the tool part, and then cool in water.

A good way to draw the temper of a side tool, with a long cutting edge, is to heat it over the fire with some blast on, holding it up four or five inches from the fire, and occasionally cooling the point in water until the color begins to show a little next to the shank or bar, when the point can be allowed to come slowly up to the same temperature.

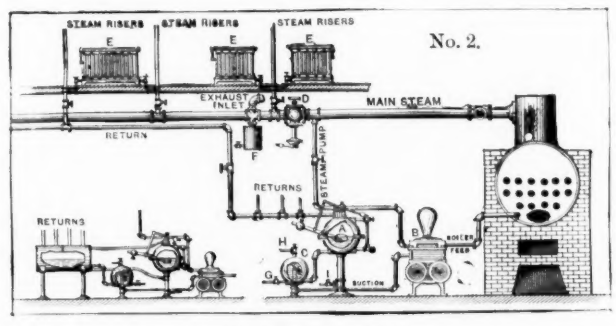
I favor the file test of hardness, while drawing the temper, only in certain cases. If the temper is drawn slowly, the color of the oxide on the surface is a sure indication of the temperature, and if the steel is uniform, and the hardening correctly done, it is a sure indication of the degree of hardness.

Drawing the temper too rapidly is one great cause of the uneven results obtained in tempering, especially where the color of the oxide is the guide, for it takes time for the oxide to assume the color due to the temperature. This can be easily proven by taking a somewhat large piece of steel and heating it until its suface is blue, then file or polish off a portion of it and see how long it will be before it assumes its original color.

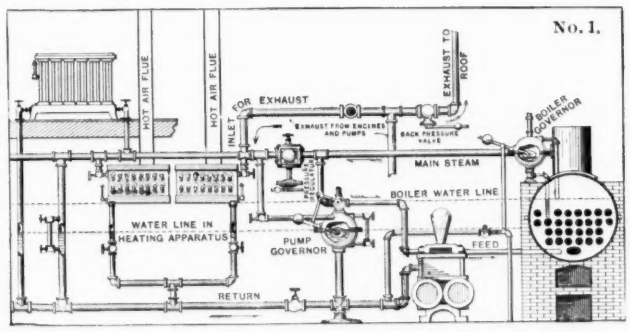
One reason why I do not like the file test is the great difference in files, as well as the variation between a sharp file and the same file dulled. I suppose, though, I have used the file test for hardness in tempering on a great many thousand pieces of steel, and I may say it is sometimes indispensable where the steel is all mixed up and you scarcely know what you have. I prefer a six-inch second cut to a finer file, as the pressure of the hand acts on fewer teeth, thus making a greater pressure on each individual tooth.

I have been in the habit of using the point of the file only about ½" back on either side of it, and as soon as this much becomes a little dull I break it off, and thus I am always sure of a sharp file.

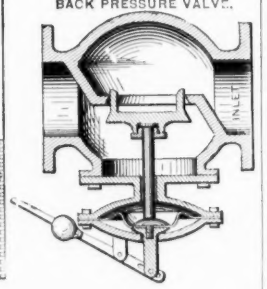
I speak of drawing the temper of a diamond point, though I know there are those who claim that the temper should not be drawn. I have used steel for diamond points which was too soft even when the temper was not drawn. But I believe every diamond point should be drawn to a light straw color, and after it is cold, if it can be scratched with a file, it is too low steel for lathe tools. The tendency is toward higher and special steels for lathe tools, and if a carbon steel is used it must be high in order to be serviceable.

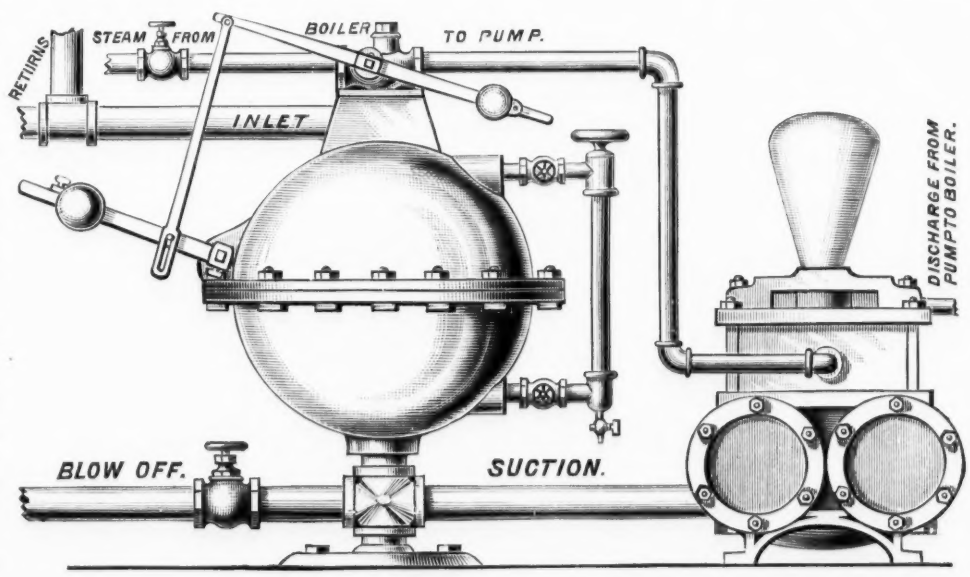


DRY RETURN SYSTEM.



WATER LINE SYSTEM.





POSITIVE ACTING PUMP GOVERNOR.

Kieley's Positive Acting Pump Governor.

The illustrations represent this governor, together with some details of its application to heating purposes. The governor will automatically start the pump when the water of condensation accumulates, and keep it running at the speed necessary to keep the heating apparatus free from water, stopping the pump when the water ceases to appear.

When placed in the cellar at the height at which the water is to be carried in the return pipes, it will seal them in such a way as to maintain a water line in the heating apparatus, thereby preventing the annoyance and the destructive effect of water hammering.

When the pump governor is used in connection with the pressure regulating valve, exhaust steam from the engine and pumps can be utilized for heating; if the exhaust steam is not sufficient for the purpose, the regulating valve will automatically open, allowing sufficient live steam to pass to keep up the necessary pressure.

Where exhaust and live steam are used together for heating, a reliable back pressure valve is required. In the one shown herewith there are no stuffing boxes to create friction; the diaphragm upon which the pressure acts enables the valve to open and close with a variation of only one pound pressure. With this valve any back pressure from 1 to 20 pounds may be maintained.

In the water line system the object is to be able to carry a lower water line in the return and relief pipes than in the boiler; to be able to return the water from a reduced or graduated pressure apparatus; to be able to use the exhaust steam from engines and pumps for heating the building, and to be able to force a return of the water of condensation from a defective gravity apparatus.

In the dry return system the returns are kept dry. *F* and *C* in this system are oil traps, which prevent oil and sludge from getting into the boiler.

This governor and other appliances are manufactured by Timothy Kieley, 9 West 13th street, New York.

A bill has been introduced in the Arkansas Senate to appropriate $20,000 for additional buildings for the Arkansas Industrial University at Fayetteville, Ark.

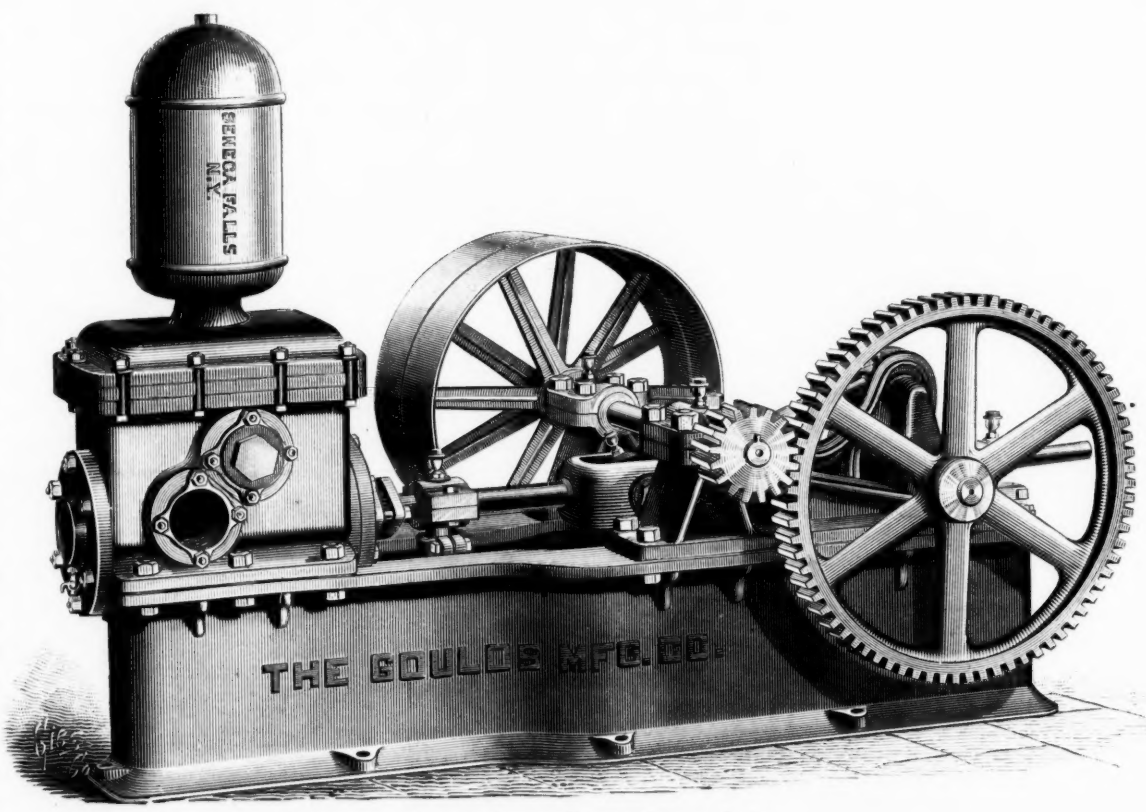
According to Sir William Turner a large whale propels itself with the power of 145 horses.

Double-Acting Power Piston Pump.

The engraving represents a pump made by the Goulds Manufacturing Co., Seneca Falls, N. Y. It has brass-lined cylinder, brass piston, brass-cased piston-rod, and brass valves, with cast-steel crank and pitman yoke. It is designed for use in mills, factories, small villages, etc.

The frame is cast-iron and the pump being geared 5 to 1 makes it strong and rigid. A yoke is attached to the piston-rod, the yoke being of such form that it acts as a guide to the pump and permits the crank to move up and down inside without touching.

These pumps are made of various sizes and will force water against 150 lbs. pressure either for fire purposes, or constant service.



Double-Acting Power Piston Pump.

"Some Notes on Steel" Discussed.

By S. W. Goodyear.

It would perhaps be better for an humble steel worker who is anxiously looking for enlightenment in the matter of some strange freaks which are attributed to the wonderful compound of iron and carbon which constitutes the well-known steel of commerce, to remain silent, when so good a writer as Mr. Coffin volunteers to explain. But, with the eminently practical, workaday fashion in which my knowledge of steel and its habits have come to me, I am extremely anxious to have any new scientific fact which I swallow as Gospel truth, appear to agree with the practice and observation of practical men. Following Mr. Coffin through the article in issue of Jan. 15 of American Machinist, I was so pleased to have found somebody discussing in such an easy, offhand way the mysteries attached to the presence of carbon in steel, that I overlooked at the time the fact that in stating how the cooling rail behaved, he had failed to make the statement consist. Let's see. A hot rail. The head convex. The flange will cool first; this will increase the convexity. But a time comes when, through change of hardening carbon to non-hardening carbon, the flange re-heats itself and re-expands enough to make the head concave. If it really does act in this way, and there was much convexity in the beginning, we must be expected to believe that in this reheating of itself the flange is really expanded to greater length than it had before the cooling began. It may be all right. It somehow looks a little queer in print. When we get more used to the carbon changes theory it may seem plain. About the re-heating of the corners, or some part of a bar in process of cooling until they are hotter than other parts which were much the hottest the moment before, why, it makes a fellow rub his eyes instinctively. It reminds one of losing sight of a balloon which has been watched and watched until it can be no longer seen, and then all at once, after having it fully settled in the mind that it is out of sight, it appears again and is seen even more plainly than before. The colleges may be the places where experiments should be made to test this matter, but at the first opportunity, the writer proposes to make a test, and the readers of the American Machinist shall have the best report of results that I can furnish. I don't mind telling you now what I expect to find, *i. e.*, if I heat a piece of steel to the proper heat for hardening and let it cool gradually until cool enough to be held in the hand, I expect to find that it has undergone a steady and continuous diminution in size from the time when the cooling began. If the unexpected takes place I'll let you know.

Next in order, I wish to congratulate Mr. Theo. D. Morgan on having had such a different and very desirable experience with heating steel from that of some of the rest of us. He says: "But once a change begins to be perceptible the entire mass becomes heated through very quickly, and the heat is strikingly uniform throughout. This is more noticeable in the billet or bar than in the cast ingot." Our trouble is to get the pieces which we heat—for hardening say—uniformly hot throughout. Is not this so? Take a piece six inches square by half an inch thick and try to heat it in the best blacksmith's fire that can be built, so as to have the heat exactly even, no corner too hot, and get rid of the black spot that seems as if it would never get hot. It is an exceedingly difficult thing for us who use an ordinary fire to heat pieces evenly. Of course we ought to have furnaces, and heat our dies, etc., as Mr. Morgan describes the heating of ingots, and blooms, but we can't afford to run a furnace for our occasional jobs of heating, and so we turn our pieces in the fire, and watch those provoking black spots which we know are not quite up to the hardening heat, while some other part is hot enough—a little too hot sometimes—and trying in vain to get the too cool place in the hottest part of the fire, we often dip the piece when we know the heat is not quite even, don't we?

As to pieces of steel, or iron, or other metal getting hotter by the action of hammer or rolls, we common folk have supposed it to be due to friction. A piece of steel or iron can be hammered by hand on the anvil to become red-hot. Of course I am answered, "latent heat;" but in the case of the cooling rail, cooling causes the contraction. Contraction must be the only force at work to free or make sensible the latent heat; unless the piece gets cooler all the time it won't contract; if it don't, the friction to set free the latent heat will not take place, and the re-heating and re-expansion cannot take place then, and if they did the contraction would stop. I said so before, "don't it?" I'm all mixed up. Next, we come to the terms hardening and non-hardening carbon, and that these are the two distinctive kinds of carbon in steel is assumed to be proven by acid test, non-hardening carbon being found in soft steel, and hardening carbon in hardened steel. Yes, which all means if steel has the right amount of carbon, sufficient carbon to be hardening steel, and is heated to hardening heat and suddenly cooled, it will become hard, and that the chemical combination of the contained carbon with the iron, brought about by raising to a certain heat, and suddenly cooling, will present to the metallurgical chemist different conditions from what would have been found before hardening. That is what we supposed all along. There has been just the least little bit of a hitch about explaining all about it, you know; that is why steel hardened for the scientists. Of course they told us that graphitic carbon was changed to combined carbon and that caused steel to harden, and we practical fellows fired an ever ready "Why?" at them, and they answered, "Don't know."

It may answer the purposes of scientific steel literature better to say that "when steel is heated to a certain temperature, called for convenience hardening temperature, its carbon will nearly all change to hardening carbon," than to say, as we do in the shop: "Heated to the right heat and suddenly cooled, steel will harden." Quoting further from the inside scientific theory we have this: "If it is now slowly cooled its carbon changes slowly to non-hardening carbon." We say, "Cooled slowly it will be soft, will be annealed." Our way of stating it is the most direct and simple. The carbon is there all the time. If the steel is heated hot enough and cooled suddenly enough it hardens. If not hot enough it will not harden. If cooled slowly from hardening heat it will be annealed. Why not say hardened carbon and non-hardened carbon? Again, we are asked to believe that there are no gradations of hardness, "that a piece heated to a graded temperature for five or six inches of its length, and plunged in cold water, will not have graded hardness, but that there will be an easily distinguished boundary between the hard and soft part." We would like to believe it, but our experience forbids. In all of the experience of steel workers there is no more universally recognized principle than that of gradations of hardness resulting from gradations of heat, or more or less sudden methods of cooling. Thousands of pieces are re-hardened daily because not sufficiently hard for the purpose for which they were designed, that can no more be filed practically than can other pieces on which the best file fails to make a scratch.

To illustrate: A chilled roll is to be turned. A tool is hardened for the purpose. It is tried with a file. If the file is shoved across it quickly, as in ordinary practice, it fails to catch at all. A few strokes would tear the teeth from the file with no injury to the tool. But moving the file very slowly under great pressure it is made to catch a little. The tool is put in use under apprehension that it will not stand. It does not. It is re-hardened; a little hotter the second time. Still it don't stand. Now the temperer having tried twice, tests the tool with a file thoroughly before the third heating, and can find no place where a scratch can be made. He says: "It don't seem as if it could be made any harder." It is, though, and with the heat just up to the right point, and a plunge into strong brine, the tool goes back to cut chilled iron as though it were old cheese. That a change takes place whenever steel is heated is evident to any person of observant mind. High heat tends to open the grain and make steel coarse and weak. Low heat will correct this. There is the "refining by hardening" (not "refining by tempering," for it is questionable if tempering refines to any appreciable extent), and the refining by working. Too great heat destroys the salutary effects of judicious working. Low heat preserves and makes available the benefits of such refining by working. By working, the grain may be made nearly as fine as it is made by judicious hardening. By too great heat for annealing or hardening the grain will be opened and the advantage of the work be lost. But there is a suitable heat at which such steel can be annealed and hardened, without disturbing the effects of the working in the least.

Yes, I am one of the old men, Mr. Coffin, and when I come to your letter of Feb. 19th issue, I feel like thanking you for the good things you say about charcoal, sulphur, green coal, good bed of fuel, mellow heat, etc., etc. I have been hammering away for years on some of these points, but I am afraid that my shop way of putting things has kept me from doing much good; still I find that you and I agree wonderfully well about hammering steel edgewise, endwise, or any otherwise we please, so that it is done intelligently. And, while it may seem as though we differed about hammering too cold, we probably agree on that point too. It is only a difference in conception of what constitutes cold hammering, probably. Take your illustration of the two cold chisels. If you mean that you will take a piece of octagon steel of say $\frac{3}{4}''$ or $\frac{7}{8}''$, and heat to a good mellow heat—a high yellow heat—and with good stalwart blows while hot the chisel shall be drawn to as nearly the shape as possible, the blows alternating between flatwise and edgewise, that is my way. If you propose to heat my chisel again for the finishing heat to the same high yellow, I say, "Hold!" Red-hot will do for me. If my chisel gets so cold that it will look black in the sunlight before my finishing blows cease, but still is hot enough to show red in the shade, I assume that by working I have refined the steel to an extent which will aid me when the chisel is hardened in doing what I propose to do, *i.e.*, refine by hardening to the utmost degree possible.

Much work, like drawing down the blade of the chisel, permits much heat—should have a mellow heat. Little work, like the finishing touches on the blade of the chisel, requires little heat, and best results easily reached indicate the low heat—forbid a high heat. That a piece of steel forged at a high heat, the forging ceasing while the piece is still quite hot, can be, by a judicious system of cooling before hardening, put in such condition as to be comparatively good, no more proves that to be the best treatment, than does the fact that by a similar treatment burned steel can be restored to show a fine fracture and great strength, prove that to burn steel is a good practice.

Steel can be forged too cold, and too hot. Yes, and I have a whole chapter on the subject struggling for a hearing, which will have to wait till next time. In the mean-

time I shall keep wrestling with the advanced theory in relation to carbons, "hardening," and "non-hardening."

Manual and Mental Training at the University of Illinois.

F. D. Baker, of University of Illinois, writes us:

"Learning and labor" is the motto of the University of Illinois, at Champaign. Not idly chosen in the first place, it still is thoroughly endorsed by trustees, faculty, and students. The attention paid in this institution to the practical part of education is well illustrated in the college of engineering. This college embraces schools in architecture, civil, mining and mechanical engineering. The school of mechanical engineering is under the direct management of Dr. S. H. Peabody, the Regent. It seeks to prepare students for work as practical mechanical engineers, to fit them to invent, design, construct and manage machinery of any kind. The instruction, while scientific, is thoroughly practical. The full course leading to a degree requires four years. Such pure mathematics are given as will prepare the student for work in the applied mathematics of mechanics' mechanism, millwork, strength of materials, prime movers, hydraulics, etc., studied later in the course. Mechanical drawing enters largely into the course.

Practice in shop work is given especial attention, and a portion of each day during the first five terms is devoted to it. The first year of shop practice consists entirely of elementary work, in wood, blacksmithing, vise, hand and machine tool work in iron. In this year work is done only for the practice it gives, and only such pieces are assigned as will best afford opportunity for instruction.

During the next two terms commercial work is given and machinery is designed and constructed. All work is done from blue prints. In the third year more attention is paid to textbook work, and very thorough courses are given in chemistry and physics, including much experimental work in the laboratories. Again, in the fourth year the designing and construction is resumed, and under competent instruction the class is required to design machinery, make working drawings and blue print them, build their patterns, take them to the foundry, do the moulding, make their castings and forgings, and finally go to the machine shop and finish up the machines ready for use.

This brief outline shows that the work here is intended to educate the hand as well as the mind. Ample provision is found for manual training in a substantial brick building 126 by 88 feet in size. The wood-working department for the school of architecture contains benches and tools for classes of twenty-four, and a full equipment of power wood-working machinery, as saws surfacers, moulding machine, shapers, boring machine, turning lathes, etc. The mechanical department embraces a pattern shop, equipped with tools for thirty-two students, machine shop with 17 vises, 8 lathes 14 to 24 inch swing, 5 to 10 foot beds, 4 hand-lathes, 2 drill presses, 2 shapers, milling machine, 22 by 22 inch by 5 foot planer, each with a complete set of small tools, Brown & Sharpe grinding machine, and complete sets of taps, dies, reamers, gauges, etc., for general use. There is also a large electric dynamo and a testing machine with capacity of 100,000 lbs. for general use in experiments. In a wing 32 by 36 feet are 16 forges, each furnished with an anvil and outfit of tools, and also a cupola. The floor of this wing is so arranged that it may be largely cleared and used for moulding purposes. A No. 5 Sturtevant fan gives blast to forges or cupola, while a smaller one gives forced draft to hoods over forges. An automatic engine, made in the shops, drives a main line of shafting, from which all power is derived and which runs the length of shops.

The tuition in this, as in the several other colleges, is free, and when a student has once matriculated any study in the University may be taken by him. That a school offering the advantages in manual training and engineering work that this State institution does, exists in Illinois, may be of much interest to many western readers of the AMERICAN MACHINIST.

The Treasury Department Takes a Hand in Car Heating.

The following circular from the Treasury Department of the U. S. Government shows the interest that is felt in the problem of car heating. The circular is self-explanatory:

TREASURY DEPARTMENT,
OFFICE OF THE SECRETARY,
WASHINGTON, D. C., Feb. 19, 1887.

To Whom it May Concern:

Congress (House of Representatives) having, on the 21st of January last, by resolution, requested the Secretary of the Treasury to make inquiries of constructors of passenger cars and of steamboats, and of other persons capable of giving useful information as to the best methods of building railroad cars and heating the same, and constructing steam vessels so as to prevent loss of property and life by fire, the Department takes this method of inviting correspondence upon the subject matter of the resolution referred to. Parties offering suggestions are requested to send with them sketches or drawings of their designs when practicable.

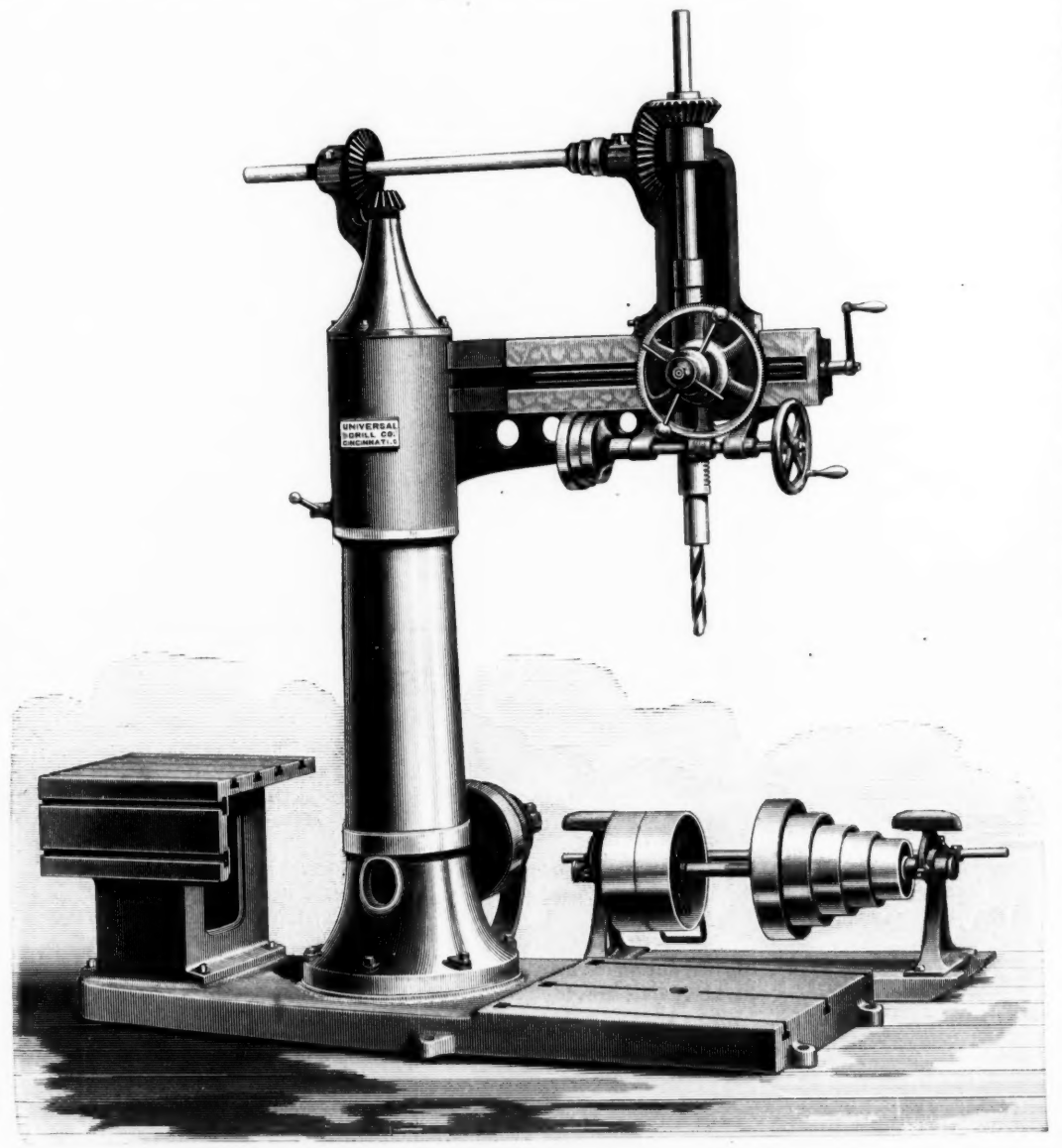
All communications upon the subjects referred to herein should be addressed to the Secretary of the Treasury, Washington, D. C., also indorsing upon the outside "Plans for heating railroad cars, etc."

Communications received after November 1, proximo will not be guaranteed consideration, as a report will have to be made to Congress at the commencement of the session in December.

C. S. FAIRCHILD,
Acting Secretary.

Radial Drilling Machine.

The drill herewith illustrated, while it does not embrace all the features of other machines made by the company, is found to answer all requirements for many shops. It will bore or drill a number of holes parallel with each other—vertically downward—anywhere within the range of the arm. The spindle is geared with unusual power, has quick return, is counterbalanced, and has automatic feed. It will readily bore holes in solid cast-iron two inches in diameter. The column which carries the arm, driving gear, spindle frame, etc., is bolted fast to base plate, making it perfectly rigid and firm. The arm is pivoted at the top of column, and has radial movement of over three-quarters of the circle. The table has both horizontal and vertical faces, and is provided with planed T slots.



RADIAL DRILLING MACHINE.

The length of arm is 3½ feet; greatest distance from sole plate to end of spindle, 52 inches; greatest distance from floor to spindle, 56 inches; total height of machine, exclusive of countershaft, 7 feet; height including countershaft, 8½ feet; total height of table from sole plate, 20 inches; size of table, 20″x20″; diameter of spindle, 1 15/16 inch; hole in spindle, Morse socket, No. 4; traverse of spindle, 15 inches; floor base required for bars, 44″x78″.

The machine is made by the Universal Radial Drill Co., Cincinnati, Ohio.

The Boston *Herald*, commenting upon the remarkable growth of losses by fire, comes to the startling conclusion that this loss will soon equal the annual saving of the people.

LETTERS FROM PRACTICAL MEN.

Dome or No Dome.

Editor American Machinist:

I see by Mr. W. E. Crane's communication in No. 9 that he does not yet understand my position on the dome and domeless boilers, notwithstanding my explanations and qualifications in my article on Horizontal Tubular Boilers; neither does he apparently understand my position on heating surfaces, notwithstanding my full and specific statement of it in my general history of stationary steam boilers, which I sent him a copy of.

To be sure, I might have answered his question on the quality of steam by saying that, with either dome or domeless boiler, under the conditions of the test he presented, there could not or would not be a difference in quality of any account; but I supposed that he, as well as others posted, would know that. Therefore I proceeded, not to intimate that the test was not reliable, but to show what the test really was, and what its comparative effect on the quality of the steam would be, and how guessing at 6,800 lbs. of coal might affect the statement of the evaporation per pound of coal and combustibles; and then left it for the judgment of those interested to draw their own conclusions. And in order to aid them, I showed what the quality of the steam was from the cylinder boilers when doing so much more duty to the heating surface; and from this comparison Mr. Crane draws the inference that I do not make a fair comparison of the heating surfaces, and I might draw the inference that he thinks I do not know the difference in the efficiency of the several kinds of heating surface, at which I am much surprised, because I supposed he had read my book on this head. But I am more surprised at the inference I may draw from Mr. Crane's representation of the effect of the reduction of the temperature of furnace heat and gases, as shown in Mr. Hoadley's test that he presents, which inference is that the duty of the heating surface on the bottom of the boiler is four-fifths that of the total heating surface, and that the tubes in a horizontal tubular boiler are a kind of economizer. I suppose Mr. Crane knows better than this; but I must leave it to the readers to judge whether or not I am justified in drawing such inference from his presentation of the test. In regard to the comparison between the heating surface of a cylinder and a tubular boiler, my book shows that I allow 9 feet in the first and 14 feet in the second. In the test presented by Mr. Crane, the cylinder boilers were made to do a horse-power to 4½ feet of heating surface, and 19 feet in the tubular. The proper proportion of duty would be as 9 to 14. We see what the quality of steam was at 4½ and 19 feet, and from this we may assume that it would have been pro rata at 9 and 14 feet; and I think it would be better from the cylinder boilers, because other tests by Mr. Hoadley and others show that the moisture in the steam may be from 1 to 200 per cent. more than in the two tests presented. In one of Mr. Hoadley's tests of domeless horizontal tubular boilers with 4-inch tubes, the duty being 10 feet of heating surface per horse-power, some of the tests showed over 200 per cent. more moisture in the steam than represented in his Lawrence test.

I have not the Lawrence test before me, so I cannot judge it, nor compare it. We all know that the kettle boils over only when we try to get more evaporation than will let the water stay below the top, and we may say that a comparatively similar ef-

fect is produced when forcing the heating surface of a boiler. The results of tests undoubtedly show a difference in quality of steam, according to the conditions, kind and duty of boilers, and Mr. Crane presents two tests which show the quality to differ 100 per cent., the one showing a little over 1 per cent., the other over 2 per cent. moisture; and the percentage of moisture runs, in well-constructed boilers of the several kinds, under reasonable expected duty from the heating surface, from 3 to 6 per cent., and it is impossible to get steam from a boiler as dry as its pressure calls for. Therefore I insist upon comparing conditions, to get at comparative results, which I believe is the only way, in the absence of tests of same boiler, under different duties, to compare with other boilers of same or other kinds. The observing engineer knows whether the quality of steam going through his engine is what it should be, and what the effect of wet or dry steam is in the supply of water to, and steaming capacity of, the boiler.

In conclusion I desire to say that I have always tried to find out what true and comparative results may be obtained in the several kinds of boilers in general use, and of those introduced to supersede them, and am always willing to concede any claim that is founded upon fair and full comparative tests, and upon none other.

William Lowe.

Moulding Special Castings.

Editor American Machinist:

A short time ago we received an order for hollow cylinders which are to be used for drying "one stave veneer buckets." The form of these cylinders is shown in Fig. 1. They are 12 inches in diameter on top, 14 inches in diameter on the bottom, with a flange 16 inches in diameter and 1 inch thick; the height is 14 inches. The lower end is closed, and the upper end nearly so, as it only has one small opening 2½ inches in diameter to admit a pressure of steam. The thickness of metal around the body of the cylinder is ⅜ of an inch. The 2½ inch opening on top was the only opening for the vent to come off.

The mould was made with the small end up, as shown in Fig. 2; anchors were put in bottom and top to hold the core in place. The core was made of dry sand. On the first mould I cut the gates at the top, as shown at *A*. But as the core was nearly the size of the mould and too long for the vent to come off at the bottom, it blowed. On the second mould I cut gates at top and bottom, as shown at *A* and *B*. Next morning I found two small holes the size of a nickel on the top, which, I suppose, were caused by a slight blow. At the third trial I gated the same as the last and flowed through about 25 pounds of iron, and had no trouble afterwards.

John X. Reynolds.

Indianapolis, Ind.

Is it a Lubricant?

Editor American Machinist:

I read your paper and have therefore heard of Mr. Fink's exploits. A friend gave me the following recipe said to be a lubricator. I have never seen Mr. Fink's recipe, but should think it might be something like this one. It does not seem as if this mixture would make a lubricator. What is your opinion of it?

6 to 7 pounds pure lime; 2 pounds pure sulphur; 1 pound bicarbonate potassium; 1 pound borax; ½ pound muriate of ammonia, dissolve in hot water; ½ pound bicarbonate of ammonia, dissolve in hot water; 1 ounce tumeric (put in last).

The above is for 40 gallons of pure water, (rain water is best); stir well and allow to stand for 36 to 40 hours.

Mix the sulphur with half the lime like a paste, the balance of the lime put in the barrel. H. K. Porter.

[Our opinion is that it will in some sense act as a lubricant, but that its value will be small compared with good oil.]

An Inquiry About Tar Cores.

Editor American Machinist:

In your issue of Nov. 20, 1886, David Spence has an article on Core Making in Foundries, in which he says he used coal tar and dry sand, and all trouble from blowing was at an end. I would like to have Mr. Spence give the process of making cores with tar and sand. I have tried it without success.

A. P. Ricker.

Varieties of Steel.

Editor American Machinist:

Dear Sir:—You are doing a good work in re-opening the question "Iron vs. Steel for Crank-Pins." It will put steel makers to their mettle to produce the exact quality needed for the purpose, and when this is done I think steel will come out ahead.

In your editorial you mention Krupp steel, Otis steel, and open-hearth steel, as if they were three different kinds of steel.

Both Krupp and Otis, however, make open-hearth steel. Otis also makes Bessemer steel, and Krupp both Bessemer and crucible. The Otis steel crank-pins which have done so well are no doubt of open-hearth steel, and it is quite possible that the Krupp pins were open-hearth steel also.

Wm. Kent.

[We only referred to the different makes of steel as mentioned in the letters from master mechanics. When simply "open-hearth" steel was named we assumed that it was not made by either Otis or Krupp.]

A Mysterious Boiler Explosion.

Editor American Machinist:

I enclose a small specimen taken from the shell of a foundry boiler which exploded in this city Feb. 26. The specimen was twisted from the shell with the naked hand, no hammer or other tool being used. The boiler was 20 feet long, 42 inches diameter, and had two 14 inch flues. I do not know the exact steam pressure at the time of the "accident," but as near as I can learn they generally carried 60 pounds. The shell was originally $\frac{5}{16}$" thick. The cause of the explosion is a mystery.

Watertown, Iowa. Jour.

[The piece which our correspondent sends us is about 2 square inches in area, and from $\frac{1}{32}$ inch to $\frac{1}{16}$ inch in thickness. There is about as much mystery in the matter as there is in the majority of boiler explosions. It is an excellent argument for some kind of boiler inspection].

The United States Treasury contained over $556,000,000 in coin, treasury notes and National bank notes on the 1st of March, according to the Treasurer's report. This vast sum is over ten dollars each for every man, woman and child in the country.

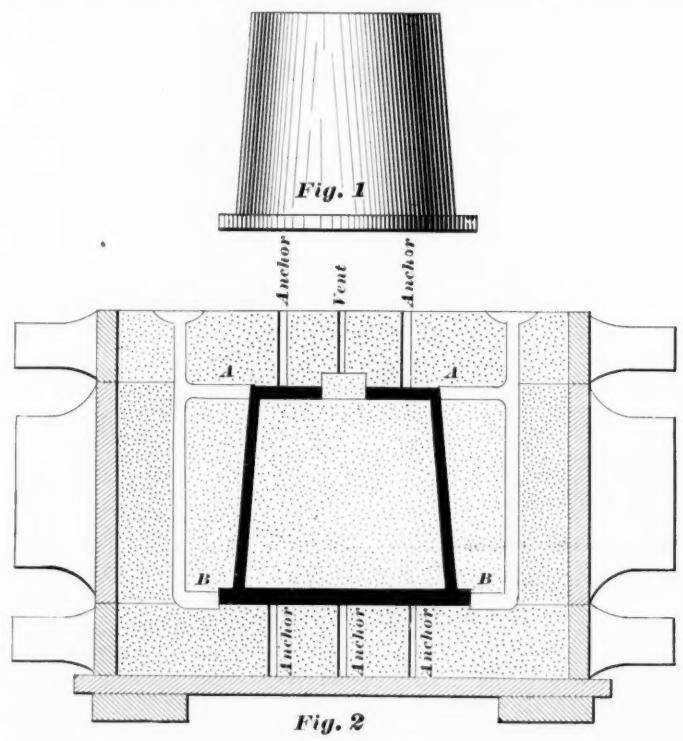


Fig. 1

Fig. 2

Moulding a Special Casting.

Report of the Committee on Standard Pipe and Pipe Threads, of the American Society of Mechanical Engineers.

Submitted at the seventh annual meeting, held in New York City, November 29 to December 3, 1886.

[Note.—This report is the one referred to on page 19 of the Proceedings. The importance of the matter of which it treats has induced the Publication Committee to order it issued as a separate paper contributed to the Society.]

The report was as follows:

Gentlemen: Your committee to whom was referred the consideration of a standard for pipe and pipe threads, have the honor to present the following report:

At a meeting of your committee held in Hartford, February 23, 1886, the request embodied in the following circular letter to the manufacturers of wrought-iron pipe in the United States was decided upon, and the letter was issued April 21, 1886, addressed to each of the companies composing the above association:

"At the Sixth Annual Meeting of the American Society of Mechanical Engineers, held in Boston, in November, 1885, a committee was appointed by the president, to confer with manufacturers of pipe, pipe dies, and pipe fittings, with a view of bringing about a uniformity in the sizes of pipe and pipe threads, and of maintaining it by the use of gauges which shall definitely represent standard sizes.

"A meeting of this committee was held in Hartford, February 23, 1886.

"The opinion of this committee is that the Briggs standard, which nearly all, if not all, of the pipe manufacturers once adopted, is the proper standard to be adhered to, and that it only requires definite co-operation on the part of pipe manufacturers with the committee, in order to bring their product strictly to that standard, and to adopt means of strictly adhering to it within practical limits.

"A copy of the minutes of the Boston meeting referred to is herewith mailed you, in which will be found the report of the discussion and subsequent recorded appointment of the committee. There is also sent you a copy of the paper upon this subject, which was read at that time before the Society, together with the report of the discussion which followed its reading.

"The committee request that the pipe manufacturers give this matter consideration, and would suggest that they appoint a committee to confer with them, with a view of bringing about the desired result, and to notify the secretary as to the date when this meeting may be held.

"Will you please give your individual aid in having such a committee appointed?

"An early answer will oblige,

"Yours very truly,

(Signed) Geo. M. Bond,
Secretary.

Frederick Grinnell, Chairman.
George Schuhmann.
Wm. J. Baldwin.
B. H. Warren.
Geo. M. Bond, Secretary.

Hartford, Conn., April 21, 1886."

There was also issued a circular letter to each of the members of the Associated Manufacturers of Cast and Malleable Iron and Brass Fittings in the United States. This letter was dated April 28, 1886, and is as follows:

"The enclosed communication, which has been sent to each of the pipe manufacturers, will explain itself.

"A copy of extract from minutes of the proceedings is also enclosed.

"We will be pleased to have your views upon the subject for our guidance in conferring with the proposed committee of pipe manufacturers.

"Yours very truly,

(Signed) Geo. M. Bond.
Secretary."

As stated in the preliminary report of your committee, submitted at the meeting of this Society, held in Chicago, May, 1886, a committee was appointed by the Manufacturers of Wrought-Iron Pipe and Boiler Tubes in the United States, at their meeting held in Philadelphia, May 12, 1886, the members of which committee, as at that time given, being:

Mr. L. W. Shallcross, Chairman, representing Messrs. Morris, Tasker & Co., limited, of Philadelphia.

Mr. J. H. Flager, representing the National Tube Works Co., of McKeesport, Pa.

Mr. L. J. Piers, representing the Allison Manufacturing Co., Philadelphia, and

Mr. Jas. H. Murdock, of Pittsburgh, Secretary to the committee.

The action taken by the Cast Iron Fittings Association is also here given:

"At a meeting of the Cast Iron Fittings Association, held in New York, May 19, 1886, the following resolution was unanimously adopted:

"'*Resolved*, That a committee of five (5) be appointed to take into consideration the matter of a standard gauge of thread.'

"The following gentlemen were named as such committee:

"Mr. R. T. Crane, President Crane Bros. Manufacturing Co., Chicago, Ill.

"Mr. C. C. Walworth, President Walworth Manufacturing Co., Boston, Mass.

"Mr. E. G. Burnham, Vice-President the Eaton, Cole & Burnham Co., Bridgeport, Conn.

"Mr. Charles Jarecki, President Jarecki Manufacturing Co., Erie, Pa.

"Mr. Carleton W. Nason, President Nason Manufacturing Co., New York city."

The action taken by the Manufacturers of Brass and Iron, Steam, Gas and Water Work of the United States, at a meeting of their association, held in Pittsburgh, May 11, 12 and 13, 1886, was that the following resolution was unanimously carried:

"'*Resolved*, That this association favors the establishment of a universal wrought-iron pipe gauge, to be used as a standard throughout the United States, and that any action taken by the manufacturers of wrought-iron pipe to accomplish this object shall have our hearty co-operation."

Soon after this preliminary report was submitted at the meeting of the society in Chicago in May, a joint conference of the committee appointed by the manufacturers of wrought-iron pipe, and your committee, was held at the Fifth Avenue Hotel, New York, June 17, 1886. The result of this conference is clearly stated in the official notification issued by Mr. L. W. Shallcross, chairman of the conference, and which is here given:

"New York, June 17, 1886.

"At a meeting of the Standard Pipe and Pipe-Thread Committee of the Manufacturers of Wrought-Iron and Boiler Tubes in the United States, held at the Fifth Avenue Hotel, this day, Thursday, June 17, 1886, at 11 o'clock A.M.

"L. W. Shallcross, in the chair.

"Jas. H. Murdock, Secretary.

"Present:

"Morris, Tasker & Co., lim., L. W. Shallcross.
"National Tube Works Co., J. H. Flagler.
"The Allison Manufacturing Co., L. J. Piers.

"Also, present in conference, members of the Standard Pipe-Thread Committee of the American Society of Mechanical Engineers, as follows:

"Frederick Grinnell, Chairman of Committee, President Providence Steam and Gas Pipe Co., Providence, R. I.

"Geo. M. Bond, Secretary of Committee, of the Pratt & Whitney Co., Hartford, Conn.

"Geo. Schuhmann, of the Reading Iron Works, Reading, Pa.

"Wm. J. Baldwin, 96 Fulton street, New York, Steam Heating Engineer.

"On motion of Mr. Flagler, seconded by Mr. Piers, that each manufacturer send to the Pratt & Whitney Co., Hartford, Conn., sample pieces of their pipe from (6) six inches diameter down, threaded on one end, to be tested by the Pratt & Whitney Co., with the Briggs standard, and a report to be made by them to each manufacturer of the state of his gauges only, as compared with the Briggs standard.

"And the Secretary be hereby instructed to notify the manufacturers, and request them to comply with this resolution without delay, so that action can be taken at the meeting of July 20th, proximo.

"Unanimously carried.

"On motion, adjourned to meet at the call of the Chairman.

"Attest:

Jas. H. Murdock, Sec'y to Committee. L. W. Shallcross, Chair. of Committee.

In accordance with the foregoing request, there were received by The Pratt & Whitney Co., for the required test, samples of pipe with threads cut on one end, which your committee has every reason to believe represented the average sizes of pipe and pipe threads, as ordinarily manufactured.

Samples were received from the following manufacturers of wrought-iron pipe, members of the association.

Messrs. The National Tube Works Co., McKeesport.
" Reading Iron Works, Reading.
" A. M. Byers & Co., Pittsburgh.
" Spang, Chalfant & Co., Pittsburgh.
" American Tube and Iron Co., Middletown, Pa.
" Conshohocken Tube Co., Conshohocken.
" Crane Bros. Manufacturing Co., Chicago.
" Morris, Tasker & Co., Limited, Philadelphia.
" Fieldhouse, Dutcher & Belden, Chicago.
" The Allison Manufacturing Co., Philadelphia.
" Jas. Hooven & Son, Norristown, Pa.
" Delaware Iron Co., New Castle, Del.

The Pittsburgh Tube Company, their new works not being at the time in operation, stated that their sizes would in general conform to those sent by the American Tube and Iron Co.

The examination and test of these sample pieces of threaded pipe was not made until August 23 and 24, 1886, owing to the late arrival of several sets necessary to complete the list. After having had the set of Briggs standard reference gauges critically verified by The Pratt & Whitney Co., the test was conducted under the conditions of confidence which were accepted by your committee, the secretary only to have personal knowledge of each manufacturer's variation. The results were collected, and were arranged in tabulated form, each column being headed with a special number, which referred to the manufacturer there represented.

This tabulated report, with general deductions appended, was submitted to the Pipe Manufacturers' Association at their regular Convention held at the Continental Hotel, Philadelphia, August 25, 1886, and soon after, reports to manufacturers individually were sent by the secretary of your committee, as requested in the resolution adopted at the conference.

The variation from the Briggs standard, as found to exist under this test, did not seem to warrant a departure from the original standard represented by the Briggs gauges, and confirmed the opinion of your committee that the Briggs standard could be adhered to.

With the exception of the three-quarters and one inch sizes, but comparatively little change would be required in the dies used by the pipe manufacturers in cutting pipe made by them for the market.

Recognizing the interests of the manufacturers of brass and cast-iron fittings, a joint conference, appointed by these associations and your committee, was called, in order to harmonize all interests involved, and to adopt a resolution expressing the sense of such a meeting for the consideration of the Pipe Manufacturers' Association.

This conference was arranged for Monday, October 25, 1886, and was held at the Fifth Avenue Hotel, New York, at 11 o'clock A. M. of that date.

There were present at this conference: of the committee representing the Wrought-Iron Pipe Manufacturers' Association, Mr. J. H. Flagler, of the National Tube Works Co.; Mr. L. W. Shallcross, chairman of the conference: of the committee appointed by the Cast-Iron Fittings Association, Mr. Carleton W. Nason, President of Nason Manufacturing Co., New York, representing also Mr. Jarecki, President of the Jarecki Manufacturing Co., Erie, Pa. There were also present, representing this Association, Mr. W. H. Douglas, Corresponding Secretary. Also there were present, representing the Manufacturers' Association of Brass and Iron, Steam, Gas and Water Work of the United States, Mr. S. L. Morison, Secretary of the Association. Of your committee there were present, Mr. William J. Baldwin, and George M. Bond, secretary of the conference. Letters were read by Mr. Carleton W. Nason, from Mr. R. T. Crane, Chicago, and Mr. C. C. Walworth, of Boston, members of their committee, who were unable to attend, stating their position in the matter. After considerable discussion the following resolution was unanimously carried:

"That it is the sense of this meeting that a common standard be adopted, and that action should proceed first from the Pipe Manufacturers, and for that reason we recommend that it should be particularly brought to their attention at the meeting to be held in Pittsburgh this week."

The meeting of the Pipe Manufacturers' Association just referred to was held at the Monongahela House, Pittsburgh, October 27, 1886.

The official notification received by your committee of the action taken by the pipe manufacturers at this meeting, is here given:

"GEO. M. BOND, ESQ.,
"Sec'y Committee Standard Pipe and
"Pipe Threads, American Society
"Mechanical Engineers, Hartford,
"Conn.

"DEAR SIR:—At a meeting of the Manufacturers of Wrought-Iron Pipe and Boiler Tubes in the United States, held at the Monongahela House, Pittsburgh, October 27, 1886, it was resolved that the Wrought-Iron Pipe Manufacturers of the United States hereby adopt the Briggs standard of gauges, and that where any manufacturer has from any cause got away from that standard, they be requested to get such corrections made as soon as possible, so as to conform to the Briggs standard.

"Yours truly,
(Signed) JAMES H. MURDOCK,
Secretary,
"Manufacturers Wrought-Iron Pipe and
"Boiler Tubes in the United States.
"PITTSBURGH, Nov. 4, 1886."

Your committee has notified officially of the above action of the Pipe Manufacturers' Association, Mr. W. H. Douglas, Corresponding Secretary Cast-Iron Fittings Association, New York; Mr. S. L. Morison, Secretary Brass Fittings Association, New York, and Mr. John Maneely, Corresponding Secretary Malleable Iron Association, Philadelphia, in the following letter, which was mailed to each from Pittsburgh, November 4:

"It is gratifying to me to advise you that at a meeting of the Manufacturers of Wrought-Iron Pipe and Boiler Tubes in the United States, held at the Monongahela House, Pittsburgh, October 27, 1886, it was resolved 'that the Wrought-Iron Pipe Manufacturers of the United States hereby adopt the Briggs standard of gauges, and that where any manufacturer has, from any cause, got away from that standard, they be requested to get such corrections as soon as possible, so as to conform to the Briggs standard.'

"Yours truly,
(Signed) "GEO. M. BOND,
Secretary,
"Committee Standard Pipe and Pipe
"Threads, American Society Mech.
"Engineers."

In concluding this report, your committee wish to express their appreciation of the assistance kindly rendered by Mr. J. H. Murdock, Secretary Manufacturers Wrought-Iron Pipe and Boiler Tubes in the United States; Mr. S. L. Morison, Secretary of the Association of Brass and Iron Fittings Manufacturers of the United States, and Mr. W. H. Douglas, Corresponding Secretary of the Cast-Iron Fittings Association, in furnishing lists of the different manufacturers of wrought-iron pipe, cast-iron and brass fittings, and who in many ways greatly facilitated the work of your committee.

Respectfully submitted,
FREDERICK GRINNELL,
Chairman.
GEO. M. BOND,
Secretary.
GEORGE SCHUHMANN.
B. H. WARREN.
WM. J. BALDWIN.
NEW YORK, Nov. 30, 1886.

ADDENDA.

The following communication, received subsequently to the presentation of the foregoing report, transmitting to your committee officially the resolution adopted by the Manufacturers' Association of Brass and Iron, Steam, Gas and Water Work, sustaining the action of the Manufacturers of Wrought-Iron Pipe, is herewith presented:

"MANUFACTURERS' ASSOCIATION
OF
BRASS AND IRON, STEAM, GAS AND WATER WORK.

"79 FULTON ST., NEW YORK, Dec. 15, 1886.

"GEORGE M. BOND, Secretary Committee
"Standard Pipe and Pipe Threads,
"American Society Mechanical Engineers,
"Care of Pratt & Whitney Co.,
"Hartford, Conn.

"DEAR SIR:—At a meeting of the Manufacturers' Association of Brass and Iron, Steam, Gas and Water Work, held at the Fifth Avenue Hotel, New York, on December 8, 1886, the following resolutions were unanimously adopted:

"'That the action of the Wrought-Iron Pipe Association, in adopting the Briggs Standard as the Standard Iron Pipe Gauge of the United States, be endorsed, and that as manufacturers of Brass and Iron, Steam, Gas and Water Work we will act in conformity with the resolution adopted by them: and that as a measure of safety to ourselves, in order to avoid any difficulty with our customers at any time, that the Secretary of this Association be authorized to correspond with the Secretaries of the Wrought-Iron Pipe, Cast-Iron Fittings and Malleable Fittings Associations, and, if acceptable to them, that an order be given by these Associations to The Pratt & Whitney Co., Hartford, Conn., for one set of Standard Gauges, and that such set of Gauges be presented to the American Society of Mechanical Engineers as a matter of reference for all our united members, to be held by them in case of any dispute arising as to whether the members of these Associations are manufacturing to the standard or not.

"'*Resolved*, That the thanks of this Association are due to Mr. Bond for his enlightened, gentlemanly and courteous manner in presenting this matter for our attention.'

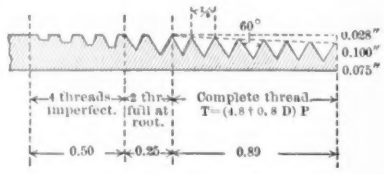
"Yours truly,
(Signed) "S. L. MORISON,
Secretary."

For comprehensive information regarding the subject of standard pipe and pipe threads, as applied in American practice, your committee would refer all who may be interested, to the Excerpt Minutes of Proceedings of the Institution of Civil Engineers of Great Britain, Vol. lxxi., Session 1882-83, Part I., containing the paper of the late Robert Briggs, C. E., presented and read after his death, on "American Practice in Warming Buildings by Steam," which also includes the discussion which followed.

Referring specially to the subject your committee has had in hand, the following, from the text and tables of the paper of Mr. Briggs is here presented, giving completely the data upon which the Briggs standard pipe thread sizes are based. * * *

"The taper employed for the conical tube-ends is uniform with all makers of tubes or fittings, namely an inclination of 1 in 32 to the axis. Custom has established also a particular length of screwed end for each different diameter of tube. Tubes of the several diameters are kept in stock by manufacturers and merchants, and form the basis of a regular trade in the apparatus for warming by steam. A knowledge of all these particulars is therefore essential for designing apparatus for the purpose. The ruling dimension in wrought-iron tube-work is the external diameter of certain nominal sizes, which are designated roughly, according to their internal diameter. These nominal sizes were mainly established in the English tube trade, between 1820 and 1840, and certain pitches of screw-thread were then adopted for them, the coarseness of the pitch varying roughly with the diameter, but in an arbitrary way, utterly devoid of regularity. The length of the screwed portion on the tube end varies with the external diameter of the tube, according to an arbitrary rule-of-thumb; whence results, for each size of tube, a certain minimum thickness of metal at the outer extremity of the tapering-screwed tube end. It is the determination of this minimum thickness of metal, for the tapering screwed end of a wrought-iron tube, which constitutes the question of mechanical interest.

"A longitudinal section of the tapering tube end, with the screw-thread as actually



formed, is shown, full size, above, for a nominal 2½-inch tube; that is, a tube of about 2½ inches internal diameter, and 2⅞ inches actual external diameter.

"The thread employed has an angle of 60°; it is slightly rounded off, both at the top and at the bottom, so that the height or depth of the thread, instead of being exactly equal to the pitch, is only four-fifths of the pitch, or equal to $0.8 \frac{1}{n}$, if n be the number of threads per inch. For the length of tube end throughout which the screw-thread continues perfect, the empirical formula used is $(0.8\ D + 4.8) \times \frac{1}{n}$, where D is the actual external diameter of the tube throughout its parallel length, and is expressed in inches. Further back, beyond the perfect threads, come two having the same taper at the bottom, but imperfect at the top. The remaining imperfect portion of the screw-thread, furthest back from the extremity of the tube, is not essential in any way to this system of joint; and its imperfection is simply incidental to the process of cutting the thread at a single operation. From the foregoing it follows that, at the very extremity of the tube, the diameter at the bottom of the thread,

$$D - \left\{ \frac{2 \times (0.8\ D + 4.8)}{32\ n} + \frac{2 \times 0.8}{n} \right\} =$$

$$D - (0.05\ D + 1.9) \times \frac{1}{n}.$$

The thickness of iron below the bottom of the thread, at the tube extremity, is empirically taken to be $= 0.0175\ D + 0.025$. Hence the actual internal diameter d of any tube is found to be, in inches,

$$d = D - (0.05\ D + 1.9) \times \frac{1}{n} - 2 \times (0.0175\ D + 0.025),$$

or

$$d = 0.965\ D - 0.05\ \frac{D}{n} - \frac{1.9}{n} - 0.05.$$

For the various sizes of tubes, ranging from ⅛ inch to 10 inches nominal internal diameter, with their corresponding numbers of screw-threads per inch, the actual internal diameter d is expressed by the following Table I. in terms of the actual external diameter D.

TABLE I.

DIAMETERS OF WROUGHT-IRON WELDED TUBES.

Nominal Internal Diameter of Tube.	Number of Screw Threads per Inch.	Actual Internal Diameter d in Terms of Actual External Diameter D.
Inches.	*No.*	*Inches.*
⅛	27	$d = 0.9631\ D - 0.1204$
¼ and ⅜	18	$d = 0.9622\ D - 0.1556$
½ and ¾	14	$d = 0.9614\ D - 0.1857$
1, 1¼, 1½ and 2	11½	$d = 0.9607\ D - 0.2152$
2½ to 10	8	$d = 0.9587\ D - 0.2875$

"The figures derived from this statement, which are of importance for practical use, are presented in detail in the accompanying Table II. in a convenient order for reference.

"The number of screw-threads per inch for the several sizes of tubes is here accepted from customary usage. It is the workman's approximation to the pitch practically desirable, and much reluctance must consequently be felt in calling it in question. Still it would have been better to investigate the general case upon the basis of a pitch ranging in closer accordance with the range of tube diameter. Thus the nominal ¼-inch tubes might have had 16 threads per inch; ⅜ inch, 14 threads; 1 and 1¼ inch, 12 threads; 1½ and 2 inches, 11 threads; 2½ to 3½ inches, 10 threads; 4 to 6 inches, 8 threads; 7 to 9 inches, 7 threads; and 10 inches, not more than 6 threads per inch. The existing numbers of threads, however, as given in Tables I. II., are now too well established to be disturbed; at all events they must be taken in any statement of present practice.

TABLE II.

STANDARD DIMENSIONS OF WROUGHT-IRON WELDED TUBES.

DIAMETER OF TUBE.			THICKNESS OF METAL.	SCREWED ENDS.	
Nominal Inside.	Actual Inside.	Actual Outside.		Number of Threads per Inch.	Length of Perfect Screw.
Inches.	*Inches.*	*Inches.*	*Inch.*	*No.*	*Inch.*
⅛	0.270	0.405	0 068	27	0.19
¼	0.364	0.540	0.088	18	0 29
⅜	0 494	0.675	0.091	18	0 30
½	0.623	0.840	0.109	14	0 39
¾	0.824	1.050	0.113	14	0.40
1	1.048	1.315	0.134	11½	0.51
1¼	1.380	1.660	0.140	11½	0.54
1½	1.610	1.900	0.145	11½	0.55
2	2.067	2.375	0 154	11½	0.58
2½	2.468	2.875	0.204	8	0.89
3	3.067	3 500	0.217	8	0.95
3½	3.548	4 000	0 226	8	1.00
4	4.026	4 500	0.237	8	1 05
4½	4.508	5.000	0.246	8	1.10
5	5.045	5.563	0 259	8	1.16
6	6.065	6.625	0.280	8	1 26
7	7 023	7.625	0.301	8	1.36
8	8 982	8.625	0 322	8	1.46
9	9 000	9 688	0.344	8	1.57
10	10.019	10.750	0.366	8	1.68

Taper of conical tube ends, 1 in 32 to axis of tube.

A correspondent in using coke melting in a cupola finds that it requires twice the time to pick out that it does when coal is used, and would like to know from those experienced in the use of coke if they have any method for preventing "hanging."

AMERICAN MACHINIST

PUBLISHED WEEKLY

BY

American Machinist Publishing Co.

Horace B. Miller, Pres't.
Jackson Bailey, Vice-Pres't.
Lycurgus B. Moore, Treas. and Sec'y.
96 Fulton Street, New York.

Jackson Bailey, Editor. Horace B. Miller, Business Manager.

F. F. Hemenway, Mechanical Engineer.

The American News Company,
Publishers' Agents, New York.
The International News Company,
11 Bouverie Street, Fleet Street, London, Eng., will receive subscriptions for the American Machinist, at 14/7 per annum, postage paid.

DEALERS SUPPLIED BY

The Albany News Company, Albany, N. Y.
The American News Company, New York, N. Y.
The Baltimore News Company, Baltimore, Md.
The Brooklyn News Company, Brooklyn, N. Y.
The Central News Company, Philadelphia, Pa.
The Cincinnati News Company, Cincinnati, Ohio.
The Cleveland News Company, Cleveland, Ohio.
The Colorado News Company, Denver, Colorado.
The Detroit News Company, Detroit, Mich.
The International News Company, New York, N. Y.
The Minnesota News Company, St. Paul, Minn.
The Montreal News Company, Montreal, Canada.
The National News Company, New York, N. Y.
The Newark News Company, Newark, N J.
The New England News Company, Boston, Mass.
The New Orleans News Company, New Orleans, La.
The New York News Company, New York, N. Y.
The Northern News Company, Troy, N. Y.
The Omaha News Company, Omaha, Neb.
The Pittsburgh News Company, Pittsburgh, Pa.
The Rhode Island News Company, Providence, R. I.
The San Francisco News Co., San Francisco, Cal.
The South West News Company, Kansas City, Mo.
The St. Louis News Company, St. Louis, Mo.
The Toronto News Co., Toronto, Ontario, Canada.
The Toronto News Co., Clifton, Ontario, Canada.
The Union News Company, New York, N. Y.
The Washington News Company, Washington, D. C.
The Western News Company, Chicago, Ill.
The Williamsburgh News Co., Brooklyn, E. D., N. Y.

SUBSCRIPTION.

$2.50 a year in advance, postage prepaid in the United States and Canada.
$3.50 a year to Foreign Countries, postage prepaid.

ADVERTISING.

Transient, 35c. per line, each insertion.
"Business Specials," 50c. a lin.

EDITORIAL ANNOUNCEMENTS.

☞ *Positively we will neither publish anything in our reading columns for pay or in consideration of advertising patronage. Those who wish to recommend their wares to our readers can do so as fully as they choose in our advertising columns, but our editorial opinions are not for sale. We give no premiums to secure either subscribers or advertisers.*

☞ *Every correspondent, in order to insure attention, should give his full name and address, not for publication, but as a guarantee of good faith.*

☞ *We are not engaged in procuring patent rights, or in selling machinery, nor have we any pet scheme to advance, or hobby to ride.*

☞ *We invite correspondence from practical machinists, engineers, inventors, draftsmen, and all those specially interested in the occupations we represent, on subjects pertaining to machinery.*

☞ *Subscribers can have the mailing address of their paper changed as often as they desire. Send both old and new addresses. Those who fail to receive their papers promptly will please notify us at once.*

NEW YORK, MARCH 19, 1887.

CONTENTS.

	PAGE
Modern Locomotive Construction. Thirty-fourth Paper. By J. G. A. Meyer	1, 2
Mechanical Work at Purdue University	2
A New Gas Light	2
Some Notes on Steel. By John Coffin	2, 3
Kieley's Positive Acting Pump	3
Double-Acting Power Piston Pump	4
"Some Notes on Steel," Discussed by S. W. Goodyear	4, 5
Manual and Mental Training at the University of Illinois	5
The Treasury Department Takes a Hand in Car Heating	5
Radial Drilling Machine	5
Letters from Practical Men—Dome or No Dome. By William Lowe—Moulding Special Casting. By John X. Reynolds—A Mysterious Boiler Explosion. By "Jour."—An Inquiry About Tar Cores. By A. P. Ricker—Varieties of Steel. By William Kent—Is it a Lubricant? By H. K. Porter	5, 6
Report of the Committee on Standard Pipe Threads of the American Society of Mechanical Engineers, submitted at the Seventh Annual Meeting	6, 7
One Way to Curb the Anthracite Coal Monopolies	8
Helping the Arming in Europe	8
Retaining Fires in Locomotives	8
Our Honor Questioned	8
Literary Notes	8
Questions and Answers	9
Manufactures	9
Machinists' Supplies and Iron	10

One Way to Curb the Anthracite Coal Monopolies.

In a recent issue we intimated that a way would some day be found, enabling the people to break some of the "squeezing machinery" that has been so long and so arrogantly employed by the anthracite coal monopolists.

Nearly all the anthracite coal now produced is mined directly or indirectly by railroad companies. But railroads built by public charter under the right of eminent domain, are, or should be, common carriers. It should be manifest to all fair-minded persons that the true and only function of a railroad is to carry freight and passengers. It is absurd to suppose that a railroad corporation, owning thousands of acres of anthracite coal lands, operating them or compelling them to lie idle, as it sees fit, will or can deal fairly with the public, with the private mine owners who try or want to try to compete with it, or even with its own employes.

The compulsory publication of freight rates provided in the inter-State commerce law, soon to go into effect, will, it is hoped, in some measure help owners of competing coal lands to the living chance heretofore denied them by the imposition of unreasonable rates and the arbitrary restriction of the amount of coal transported. But there is still room for the favoritism in the allotment of transportation and terminal facilities, sure to be piled up against them by the great railroad corporations competing with them as miners on a colossal scale. While most of the Pennsylvania anthracite coal lands are owned by the railroads in question, there is, we believe, acreage enough held by private individuals and companies to materially affect the existing situation, if the owners are permitted to mine, ship and sell without hindrance on the part of the coal railroads.

Separate the business of railroading under public charter as common carriers, from that of mining, and give all coal producers an equal chance before the law, and we shall hear of fewer meetings in New York hotel parlors, for the enforced restriction of production down to one-half or one-third of the annual capacity of the mines, in order that the coal carriers may also heap up profits as coal producers on the basis of inflated land values.

So large a proportion of the anthracite coal produced in the State of Pennsylvania is consumed outside the borders of that State, that any sytem of regulation, to be effective, must take that fact into account.

While the question of constitutionality would doubtless be raised, the right to regulate commerce between the States is expressly given to Congress by the Constitution of the United States. The argument is a strong one, that this power necessarily includes the power to so regulate inter-State commerce, as to insure equity to all interests in the management of inter-State railroads.

With this end in view let Congress enact a law supplementary to the inter-State Commerce act, providing that, on and after a certain future date, no railroad corporation doing an inter-State business shall be permitted to mine coal except for its own consumption. Such railroad corporations should also be forbidden to hold in any manner or degree a property interest in any coal mining business, except to the extent of their own wants as users.

Furthermore, to discourage evasion by the familiar device of "auxiliary" companies, it should also be provided that no person holding any property interest or employment in the business of mining or selling coal to be shipped over a railroad doing an inter-State business, should be eligible to serve as director or officer of that road.

Of course no provision of the latter kind would wholly cover the case, as the same individuals might still own a controlling interest in both railroad and mining corporations, but the necessity of intrusting the direction and administration of such vast interests, under the law, to persons not joint owners in both, could hardly fail in time to produce results favorable to disinterested management.

It is known that a State law of similar purport has long been on the statute books of Pennsylvania, but the legislators who enacted it made it a dead letter, by failure to provide any penalty for its enforcement. Prior rights under previously granted State charters have also been pleaded against its enforcement in the case of some of the companies. But such a plea made on behalf of a railroad corporation doing an inter-State business, would stand on quite another basis when raised against an equitable regulation of this kind, coming from the General Government.

It need hardly be added that the proposed law should provide adequate penalties for its enforcement.

Helping the Arming in Europe.

War is always to be deplored, but ample preparations for war often insure peace. We can therefore view the preparations for war in Europe with a great deal of complacency. It costs a great deal for armament, but some of the money is being spent on this side of the Atlantic, and the probability is that a larger portion will be spent here. Not only are American fire-arms and cartridges in demand, but there is a greater call for machinery to make arms. An establishment in Bridgeport, Conn., is filling what is believed to be a very large order for machinery for the French Government. The machinery is to be used in the manufacture of fire-arms. An establishment in Brooklyn is making a lot of drop hammers for French armories. Of course the details of these orders are kept partly secret. Others of the kind are doubtless being filled, which the public know nothing about. A Philadelphia iron shipbuilding establishment has submitted plans to the Russian Government for the construction of a large war vessel. The Italian Government, feeling the necessity of having the most efficient weapons, has sent to Hartford, Conn., for 175 Gardner machine guns. While we are at peace with all the world our workshops can supply every nation in Europe with something they are likely to want in the way of war material. Let them keep on arming.

Retaining Fires in Locomotives.

The Reading Railroad Company is about to adopt a new method in retaining the fires in their large locomotives instead of drawing them at the end of each trip. Heretofore a large quantity of wood was kept on hand and a number of men employed in looking after the fires. But now the firemen are to sprinkle the fires with a small quantity of soft coal or coke, whereby the fires are kept in good condition until the engines are needed. This new mode of retaining the fires is the outcome of a series of experiments brought to a successful conclusion by C. G. Steffe, of Reading, traveling engineer of the Philadelphia and Reading Railroad Company.

Our Honor Questioned.

A reader in Philadelphia finds fault with the American Machinist, and as it is our policy to answer criticisms fairly, we publish his letter. He says:

I have been buying your paper principally for the series of articles on Practical Drawing, and have been very much disappointed twice to find that these articles are not continuous with each issue. For this reason the value of the paper is much lessened for my use, and the honor of the management has thus opened itself to question in my mind.

If the writer of the above wishes to learn mechanical drawing without concerning himself particularly in any other mechanical work, he will not be a very valuable workman in a shop drawing room. We never promised to continue any series of articles in every issue until completed. It would be impossible to keep each series running that way. No other reader has complained about the method of publishing Mr. Meyer's articles on mechanical drawing, but we have had many letters commending those articles. We trust that if our Philadelphia critic reads the two copies of the American Machinist he will be convinced that no part of the ten cents he paid for them has been squandered.

A week or two ago we received an anonymous circular calling attention to a bill before Congress, and a similar one before the State Legislature at Albany. The first bill makes it a felony to publish "filthy or disgusting news or advertisements through the U. S. mails," and the second, which had passed the Assembly, prohibits the publication of advertisements relative to "diseases of a private nature." The circular is headed "A Serious blow at Newspaper Advertising," and urges the parties receiving it to "at once communicate with the Congressman and Senator of your district." The purport of these bills is good.

The character of the sensational matter published in many daily and weekly newspapers is such as to demand some legal action in the way of restraint. Often there seems to be a rivalry between certain newspapers as to which can publish the most filthy and disgusting matter under the disguise of news. "Liberty of the press" ought not to extend to license to spread indecency. But there are newspapers with high pretensions to virtue, that would not publish anything sensational in their reading columns, yet they do not hesitate to smirch their advertising columns with announcements referring to disgusting matters. We believe in the desirability of both State and national laws to abate the evil mentioned.

An exchange says: "Several large European silk factories are soon to be erected at Paterson, N. J." How silk factories at Paterson can be European we are not informed. They may be owned largely in Europe, but such ownership would no more make them European than it would the Erie railroad, the securities of which are held to quite an extent on the other side of the Atlantic. Perhaps, however, the factories are to be made European so as to fabricate a reason for labeling the products with a foreign mark.

Literary Notes.

ON THE CONVERSION OF HEAT INTO WORK. A practical hand-book on heat engines. By Wm. Anderson, M. Inst., C. E. Published by D. Van Nostrand, New York.

In this work the author has made the effort, as he says, to popularize "the doctrine that, in heat engines, the work given out is due to the conversion of the molecular motion of heat into the visible motion which it is desirable to produce." It is not an easy matter to rid this subject of formulas that perplex the average reader, but this appears to have been done quite as well as could be expected, while practical examples are freely used to assist the reader to a better understanding of the more complex points.

The author impresses the reader from the beginning as one who clearly understands the subject, and also as being able to state facts plainly and pleasingly. The book, we should say, is one that will become popular

Shoppell's Modern Houses, No. 5, is before us. It contains a large number of perspective views and floor plans of the best style of modern houses, ranging from modest cottages to the more elaborate and expensive dwellings. Any one can pick out from this publication the style of house he likes. He can then procure from the publishers, the Co-operative Building Plan Association, 191 Broadway, New York, working plans, detail drawings and every other information necessary to build, for a small expense. Eight thousand houses have been built from Shoppell's plans. The cost of "Shoppell's Modern Houses" is $1 per number.

QUESTIONS AND ANSWERS.

Under this head we propose to answer questions sent us, pertaining to our specialty, correctly, and according to common-sense methods.

Every question, to insure any attention, must invariably be accompanied by the writer's name and address If so requested, neither name, correct initials nor location will be published.

(119) A. J., Lowell, Mass., asks: How can I cement a piece of gold-plated brass to pearl? *A.*—Use cement such as you can buy almost anywhere for cementing earthenware.

(120) C. B., Cincinnati, Ohio, writes: I am working at a planer, and have some plates of chrome steel that are so hard that I cannot plane them. Can you suggest any plan? *A.*—We cannot suggest any plan except to use good steel for tool, make it very hard, and run the planer slow enough so that the tool will stand.

(121) F. O., Bangor, Maine, asks: What would be the proper size for spring packing rings, two being used, for cylinders 3, 4, 5 and 6 inches diameter? *A.*—Turn the rings from 3-32 inch to 3-16 inch larger than cylinders for the sizes of cylinders named; ¼ inch to ⅜ inch wide, and leave from ⅛ inch to 3-16 inch metal, according as you find you can spring over without breaking.

(122) H. A. B., Mason, Mich., asks: 1. What size steel rod would I have to use to make a coil spring equal to one-half horse-power? *A.*—That depends upon how long you expect to use the half-horse-power. You cannot make a spring that will develop one-half horse-power for time enough to be of any practical use. 2. What is the difference between an inspirator and an injector? *A.*—An inspirator is a special form of injector.

(123) A. C., Springfield, Ohio, writes: A journal is 4 inches diameter and 6 inches long, sustaining a shaft and fly-wheel. A claims that doubling the length of journal increases the friction one-half. B claims that doubling the length of journal will diminish the friction. Which is right? *A.*—Theoretically there will be no difference in friction. Practically it is a question of what the pressure is, and whether springing is likely to take place.

(124) C. E. H., Brookings, Dak., writes: I have charge of a Corliss engine, 14"x42", running 85 revolutions. The balance-wheel was broken, and two bolts, weighing about 30 lbs., were put in to support one of the arms. Will this throw the wheel out of balance enough to be noticed? *A.*—If you cannot notice it, it is fair to assume that it does not do much harm. You can practically restore the balance by fastening a piece of cast-iron to the rim opposite the bolts.

(125) G. B., Burlington, Iowa, asks: 1. What is the construction of the Leclanche battery? *A.*—You will find an engraving, with description of this battery, in Ganot's Physics. We could not give an intelligible description in this space. 2. Why is not cast-iron serviceable for electro-magnet cores, and what kind of iron is best? *A.*—We cannot give a scientific reason why cast-iron will not answer. Soft wrought-iron is found to be best. 3. In batteries where a stick of carbon is used, will a piece of retort carbon from gas-works answer the purpose? *A.*—It will answer fairly well.

(126) W. W., Auburn, N. Y., asks: Is there any packing made that will pack a half-inch plunger steam-tight, and cause less friction than rubber? *A.*—The question of the best kind of packing depends a good deal upon conditions. There are many kinds of good packing in the market, and we cannot suggest anything better than a trial to find which is the best for your purpose. If there is ample room for packing, any one of a half-dozen kinds will permit the rod to work without much friction; if there is but little room, you will not be able to pack it so but what there will be considerable friction.

(127) C. B., Watertown, N. Y., asks: 1. How is the crystallized surface seen on brass-work, such as is highly-finished, produced? The finish I refer to is not that produced by the oil-stone. *A.*—We presume the finish to which you refer is produced by the use of a scraper, kept very smooth and sharp by the use of an oil-stone. 2. How can I make a transparent lacquer for such work? *A.*—Mix in a clean vessel 1½ ounces of powdered gamboge, 3½ ounces powdered gum sandarach, ¾ of a pound of shellac, and 2 gallons spirit of wine. After thoroughly agitating, strain and add one pint of turpentine, thoroughly mixing the whole.

(128) R. A. W., South Amboy, N. J., writes: 1. I wish to lift a weight of fifty tons with a wrought-iron lever five feet long. Weight, one foot from fulcrum: power, four feet from weight. The lever has to make ten lifts per minute, three inches high. How large will the lever have to be? *A.*—The lever should be 11¼ inches deep and 3½ inches wide at the section to which the weight is applied. Leaving the width the same throughout, the depth of the lever may be reduced one-half at the ends. In these calculations we have taken 2,000 lbs. per ton. 2. How do you figure the safe working strain of levers? *A.*—See any good Engineers' Pocket Book.

BUSINESS SPECIALS

Transient Advertisements 50 cents a line for each insertion under this head. About seven words make a line. Copy should be sent to reach us not later than Wednesday for the ensuing week's issue.

Shafting Straighteners. J. H. Wells, Tampa, Fla.

Edw. Sears, Wood Engraver, 169 William st., N.Y.

Steel Name Stamps, etc. J. B. Roney, Lynn, Mass.

J. Clayton, Air Compressors, Rock Drills, 43 Dey st, NY

Light articles built to order by the American Sewing Machine Co., Philadelphia, Pa.

The Best Upright Hammers run by belt are made by W. P. Duncan & Co., Bellefonte, Pa.

R. Dudgeon, 24 Columbia st., New York, Improved Hydraulic Jacks and Roller Tube Expanders.

Pattern and Brand Letters. Vanderburgh, Wells & Co., cor. Fulton and Dutch sts., New York.

"How to Keep Boilers Clean." A book mailed free, by James E. Hotchkiss, 93 John st., N. Y.

Solid Nickel-Seated "Pop" Safety Valves. Consolidated Safety Valve Co., 111 Liberty st., N. Y.

Robbs' Patent Composition for case-hardening; send for circular. F. W. Tasney, Paterson, N. J.

"Bradley's Power Hammers, the best in the world." 20 sizes. Bradley & Co., Syracuse, N. Y.

Davis Key-Seating Machines, kept in stock, by Manning, Maxwell & Moore, 111 Liberty st., N. Y.

20", 25," 28" B.G. and S. F. upright drills for immediate delivery. Currier & Snyder, Worcester, Mass.

Ice and Refrigerating Machines. 120 built, and all successful, by David Boyle, 521 Monroe, Chicago, Ill.

Veneer Machines, with latest improvements. Farrel Fdy. & Mch. Co., Ansonia, Ct. Send for circular.

20,000 addresses of steam users and users of mach. in 10 States, $10. J. N. Mills Pub. Co., 30 Vesey st., N. Y.

Selden Packing, for stuffing-box, with or without rubber core. Randolph Brandt, 38 Cortlandt st., NY

Drawing Materials, all kinds. Get catalogue. Mention this paper. G. S. Woolman, 116 Fulton st., N. Y.

The Improved Tabor Steam Engine Indicator, made and sold by The Ashcroft Mfg. Co. 111 Liberty st., N. Y.

Engine Lathes, Hand Lathes, and other fine tools, Assortment large; prices low. Frasse & Co., 92 Park row, N. Y.

Complete Gear-Cutting Attachment; can be fitted to any lathe from 8" to 14" swing; $40. S. M. York, Cleveland, Ohio.

Twelve H. P. Upright Engine and four-spindle Drill, first-class, $125 each. The Coulter & McKenzie Machine Co., Bridgeport, Conn.

Split Pulleys at low prices, and of same strength and appearance as Whole Pulleys. Yocum & Son's Shafting Works, Drinker st., Philadelphia, Pa.

"Morrison's Practical Engineer." A complete treatise (200 pp.) on steam and general mach. Mailed on receipt of $1. W. A. Morrison, Box 373, Lowell, Mass.

Machinists' supplies, brass goods m'f'rs supplies, polishing materials, all kinds wire, metals, etc; in any quantity. Jordan & Gottfried, 208 Canal st., N. Y.

Curtis Pressure Regulators, Curtis Return Trap. Curtis Damper Regulator. See Feb 5, p. 11. Send for circular No. 17. Curtis Reg. Co., Boston, Mass.

The Holly Manufacturing Company, of Lockport, N. Y., will send, on application, their pamphlet illustrating pumping machinery and reports of duty trials.

Practical Handbook on Pump Construction. Various kinds and materials to be made of for different purposes. By P. R. Bjorling. Nine plates, 12mo., $1.50. E. & F. N. Spon, publishers, 35 Murray street, New York.

St. John Improved Self-adjusting Cylinder Packing, for marine and stationary engines and locomotives; applicable to water, air, oil and ammonia pumps. For durability and minimum of friction, it is unexcelled. Send for pamphlet. Address, Balance Valve and Piston Packing Co., room 58, 280 Broadway, New York.

"Indicator Practice and Steam Engine Economy." By F. F. Hemenway. Contains plain directions for using the indicator, and making all required calculations from the diagram; also the principles of economy in operating steam engines, and current practice in testing engines and boilers. Price, $2 post-paid. Published by John Wiley & Sons, 15 Astor Place, New York.

"Binders" for the AMERICAN MACHINIST. Two styles—the "Common Sense," as heretofore sold by us, and mailed to any address at $1.00 each, and the "New Handy," mailed at 50c. each. The former has stiff board covers, while the latter has flexible covers, the full page opening flat. Either will hold the entire 52 issues of any volume. AMERICAN MACHINIST PUB'G CO., 96 Fulton st., New York.

MANUFACTURES.

The Reading Iron Works pay out $100,000 per month in wages.

The Fort Smith (Ark.) Bridge Company has been organized, with $400,000 capital.

P. H. Thompson will build an iron foundry and a planing mill at Salisbury, N. C.

P. Pond, Southern Pines, N. C., will receive proposals for putting in water-works.

The Chester Foundry and Machine Company, of Chester, Pa., will erect a foundry.

Harlan Wellman, Catlettsburgh, Ky., is increasing the capacity of his machine shop.

Hon. A. B. Valentine, Bennington, Vt., will erect a three-story brick knitting mill.

An ice factory and a foundry are being erected at Taylor, Tex., by Mr. McCormick.

Peter M. Ohmeis will build a $9,000 extension to his factory, 517 Washington street, New York.

The Pulaski Iron Company, of Pulaski City, Va., will erect a 200-ton iron furnace to cost $200,000.

Hugh Smith, Newark, N. J., will build a four-story factory, 30x46 feet, at 27 and 29 Hoyt street.

A company has been organized at Memphis, Tenn., to start a manufacturing town near that city.

Stove works are reported to be erected at Oxanna, Ala. J. Baxter Allen can give information.

Pope, Ashton & Rose are building a machine shop, pump factory and saw mill at Santa Fe, Tenn.

Bolt and nut works are to be started in Reading, Pa., upon the co-operative plan, with a capital of $80,000.

An effort is being made to establish a blast furnace at Tioga, Pa. The capital stock is to be $100,000.

The wages of the laborers at the Elba Iron Works, Pittsburgh, have been increased from $1.25 to $1.46½ per day.

Parties from Canada have purchased a site at Mt. Holly, N. C., and will build a $100,000 furniture factory.

The Ivens & Son Machinery Company, New Orleans, La., will move their entire plant to Decatur, Ala.

It is probable that a plow factory will shortly be erected at Columbia, Tenn. J. T. Craik can give information.

It is stated that the Ironton Hoe and Tool Company, Ironton, O., will move their factory to South Pittsburg, Tenn.

T. J. Reaney, of Nashville, Tenn., will form a company at Chattanooga to manufacture woodworking machinery.

Vilas, Neb., is excited over the discovery of soft coal at that place. The find was made while digging the town well.

Denton, Tex., wants a paper mill, and the Board of Trade recently held a meeting to promote the plan for its construction.

C. J. De Witt, Pioneer, Ohio, is arranging to locate a colony at Middleburg, N. C., and start one or more manufacturing enterprises.

The Beacon Valley Rubber Company, after hesitating for some weeks between Bridgeport and Waterbury, Conn., has decided to locate in Bridgeport.

The blacksmith and machine shops of the Savannah, Florida and Western Railroad Company, Savannah, Ga., recently burned, will immediately be rebuilt.

The Rome Cotton Factory, Rome, Ga., will build a two-story addition, 50x70 feet, to their factory, and put in additional machinery, at a cost of about $10,000.

Owing to the increasing demand of their business' Peck Bros. & Co., of New Haven, Conn., will enlarge their brass foundry. Work on a four-story addition will soon begin.

The total capital invested in Fall River cotton mills is $16,118,000, and total dividends paid out in 1886, $1,017,350, or an average of 6⅓ per cent. on the capital invested.

The Westinghouse Electric Light Company has filed a paper in the State Department of Pennsylvania, showing an increase of capital stock from $1,000,000 to $5,000,000.

The Calera Furnace and Charcoal Company, Calera, Ala., has been reorganized with a capital stock of $350,000, and they will begin work on their 50-ton furnace shortly.

Mr. Richard Cross, late foreman of the Taylor & Boggis Foundry Company, has started a new foundry in the old McNairy & Claflin works, Cleveland. —*Iron Trade Review.*

The sum of $10,000 has been raised by the citizens of Alexandria, La., as a bonus for Atlanta parties, who are to erect a mammoth cotton compress at Alexandria this spring.

J. F. Wilson, chief engineer for the Equitable Life Assurance Company, has awarded the contract for a 450 horse-power engine to the Watts-Campbell Company, of Newark, N. J.

Wm. Rogers and Farrelly Alden, of Pittsburgh, Pa., have closed negotiations for five acres of land near Freeport, on which to erect a large works for the manufacture of Russian sheet-iron.

A company is being formed at Bentonsport, Iowa, to build an immense cotton mill at that point. The factory will open with 6,500 spindles, and its capacity will be 5,000 yards of goods per day.

C. E. James, S. B. Strang, W. S. Marshall, J. W. Adams and H. Clay Adams have chartered at Chattanooga, Tenn., the Chattanooga Car and Foundry Company, to put the Wason Car Works in operation.

The new Muskegon Car Works, Muskegon, Mich., will be put in operation in a few weeks. The $100,000 capital has been subscribed, and twenty-five per cent. paid in. The capacity of the works will be 3,000 cars annually.

W. E. Tanner, of Richmond, formerly president of the Tanner-Delany Engineering Company, at Richmond, recently visited Birmingham for the purpose of organizing a rolling mill company. A company will be organized.

T. Kieley, 9 West Thirteenth street, New York, will place one of his pump governors in connection with the heating system of the Equitable Building, New York. Exhaust steam, so far as it goes, will be used for heating this building.

Boiler works are to be built at Calera, Ala. The Calera Land Company can give particulars. They will erect a bank building, and are negotiating for the erection of a handle factory and stove works.—*Baltimore Manufacturers' Record.*

Perry & Co., of Albany, will not employ convicts at Sing Sing to make their stoves hereafter. A portion of the plant will be removed to South Pittsburgh, Penn., and the rest to Albany. About 500 men will be employed at South Pittsburgh.

It is stated that the money has been subscribed to build the large sugar refinery at Baltimore, previously reported. The capital stock, it is said, is to be $1,500,006. Mr. William Keyser can probably give information.—*Baltimore Manufacturers' Record.*

The Boston and Albany Railroad Company have accepted two monster locomotives constructed by the Baldwin Locomotive Works, of Philadelphia, and placed orders with them for twenty-three others, at a total cost of a quarter of a million dollars.

Gordon, Strobel & Laureau, Limited, Philadelphia, have recently contracted to build seven complete blast furnace plants in the South—three at Sheffield, Ala., one at Decatur, one at Birmingham, and two near Nashville, Tenn. All are to be completed within eighteen months.

The new works of the Simonds Rolling Machine Company, of Fitchburg, Mass., are well towards completion, and will be ready to start up in the course of the next thirty days. They will manufacture a variety of roller-forged steel specialties under the patents granted to Mr. George T. Simonds.

The manufacturers of stoves in St. Louis have replied to the demands made by the Stove Moulders' Union that the wages of moulders be increased 15 per cent., that the condition of the trade does not warrant so great an advance at this time, but promise that on June 1 an advance of 10 per cent. will be made.

The Washington C. H. Nail and Iron Company, Washington Court House, Ohio, has been incorporated with a capital of $100,000. The incorporators are Martin Grove, F. C. Coffman, S. W. Cissna, Dr. J. F. Dennis, John N. Vandeman and Frank Chaffin. The firm will erect a mill, and operations are expected to begin within a year.—*American Manufacturer.*

Wyman & Gordon, manufacturers of drop forgings, 30 Bradley street, Worcester, Mass., have issued a neat pocket catalogue of their specialties, the most notable of which are a wood-workers' vise and a quick-action vise, which is in use at many railroad shops, pattern shops, furniture works, and machine works generally. Their forgings cover a wide range.

The Standard Oil Company intends to build a large iron mill near Oil City, Pa., for the manufacture of hoop-iron and wrought-iron pipes. The company consumes about 250 tons of hoops daily for the 50,000 barrels of oil imported, and is also one of the leading consumers of wrought-iron pipes. The mill would need about 150 puddling furnaces to make the necessary product.

E. P. Bullard, proprietor of the Bridgeport Machine Tool Works, will, on April 1, remove his well-known machinery depot from 14 Dey street to 72 Warren street and 62 College place, New York. He is agent for the Brown & Sharpe Mfg. Company, Hilles & Jones, P. Blaisdell & Co., National Machinery Company, and Allen's portable and stationary riveters. His special line is iron-working machinery of all kinds.

The annual meeting of the stockholders of the Billings & Spencer Co., of Hartford, was held recently. The old board of directors were re-elected, viz.: C. E. Billings, Dr. H. P. Stearns, C. M. Spencer, M. W. Graves, L. H. Holt, Silas Chapman and E. H. Stocker. At a subsequent meeting of the directors C. E. Billings was chosen president and superintendent; L. H. Holt, treasurer; and E. H. Stocker, secretary. The business of the company is flourishing, and there are no prospects that it will not continue so.

It is reported that the shoe manufacturing firm of Valpey & Anthony, of Lynn, Mass., has purchased a large tract of land at Leominster, on which are the ruins of a large factory that was burned several years ago. Work has already been commenced on the new factory foundation. The factory is going to be 100 feet long by 35 feet wide, with basement, and three stories high. One end is to be of brick, the intention of the firm being to add in the near future a wing as large as the main building, the brick-work to serve as a safety wall in case of fire. —*Boston Commercial Bulletin.*

Recent sales by the Straight Line Engine Company, Syracuse, N. Y., are: One 6"x12", to the Wise Fabric Company, Homer, N. Y.; one 9"x12", to E. M. Jones & Co., Cleveland, Ohio; one 9"x12", to Williams & Potter, New York; one 11"x16", for Tuxedo Park, New York; one 10"x16" to Produce Exchange, New York (third order); one 11"x16", to the Athletic Club, New York; one 2"x14", to E. M. Johnson, New York; three 11"x16" and three 9"x12", for the Mikado's Palace, at Tokio, Japan. The company occupy leased buildings at Syracuse, which their business has outgrown. There is a probability that some town that is anxious for the growth of manufacturing could secure the location of this company.

Machinists' Supplies and Iron.

NEW YORK, March 3, 1887.

While the demand for American pig is rated as moderate, it is noticeable that there is no accumulation of stock, and no inclination to shade prices. Standard brands of Lehigh continue to sell at $21.50 to $22.50 for No. 1 X; $20.50 to $21 for No. 2 X; Grey Forge, $18.50 to $19.

Scotch Pig—Quotations are unchanged, at Coltness, $23 to $23.50; Gartsherrie, $22 to $22.50; Eglinton, $21 to $21.50; Langloan, $22 to $22.50; Dalmellington, $21 to $21.50.

Lead—Small transactions have occurred at 4.45c.

Antimony—Hallett's, 7¼c.; Cookson's, 9c.

Copper—There is little strength in the market Baltimore has been offered at 9½c. without takers, and Lake is equally dull at 10¾c.

✲WANTED✲

"Situation and Help" Advertisements only inserted under this head. Rate, 30 cents a line for each insertion. About seven words make a line. Copy should be sent to reach us not later than Wednesday morning for the ensuing week's issue.

Wanted—Situation as foreman patternmaker; good reference. Address S. B., AM. MACHINIST.

Wanted — Situation by a boilermaker; some Western State preferred. Address A. C., AM. MACHINIST.

Wanted—Situation by an experienced patternmaker; first-class references. Address Patterns, AM. MACHINIST.

A traveling salesman is open for engagement; is a practical machinist and engineer. Address C., AM. MACHINIST.

A first-class pract. and theoret. draftsman and engineer wants position; can take charge of drawing room. Address M. E. & D., AM. MACHINIST.

Wanted—A thoroughly competent foreman for machine shop; one who understands handling heavy work and machine building. Address Pencoyd Iron Works, Pencoyd, Pa.

A draftsman and designer, of long experience on steam and general machinery, is in search of a good situation, South or West. Address E. F. J., AM. MACHINIST.

Engineer and machinist wants to change present charge; practical and theoretical; practice covers care of boilers, engines, pumps, shafting, electric lighting, etc. Address Corliss Engine, Newark, N. J.

A good die-sinker wanted; one who understands making dies complete for drop forgings. Address, stating age, experience and wages expected, Dies, box 13, AM. MACHINIST.

Wanted—By a practical die sinker and tool-maker and drop forge worker, a position as foreman or superintendent; best of references given. Address Expert, AM. MACHINIST.

Wanted—Competent foreman to take charge of a machine shop employing fifty men on the general work of this State; write, stating age, previous experience, references, and salary expected. Address applications to Box K, Muskegon, Mich.

Boilermaker—To do laying out and assist foreman at the Oil City Boiler Works; must be sober, steady and energetic. Address, giving age, experience and wages expected, Jas. Barclay, Supt., Oil City, Pa.

Wanted — Mechanical superintendent to take charge of construction of harvester and binders, reapers, mowers, horse rakes and steel plows; must have good executive ability and practical knowledge of the business, with all the latest methods of doing work; state age and salary expected. Address Frost & Wood, Smith's Falls, Ontario, Canada.

✢ MISCELLANEOUS WANTS. ✢

Advertisements will be inserted under this head at 35 cents per line, each insertion.

The Cyclone Steam Flue Cleaner is king, and has no rival. Crescent Mfg. Co., Cleveland, Ohio.

Crescent grease cup for shafting beats them all. Sample free. Crescent Mfg. Co., Cleveland, Ohio.

Light mach'y of all kinds built at short notice Edmund Mills, 8 Dey st., Jersey City Heights, N. J.

Special tools and machines for mfg. designed and built to order; mechanical and Patent Office drawings. Weston & Smith, Syracuse, N. Y.

For Sale—One 1½" Merriman bolt-cutter, one 20' swing, 12 ft. bed, engine lathe, both new. The McLagon Foundry Co., New Haven, Ct.

For Sale—One Lathe, 28" swing, 20 feet between centers; one jig saw, one wood-turners' lathe. A. L. Henderer, Wilmington, Del.

For Sale—Low figure, in good order, four stationary engines—one each of thirty-five, forty, fifty and sixty horse-power. Address Pratt & Letchworth, Buffalo, N. Y.

Lag screws, nuts and washers, wrenches, hammers, taps, dies, screw plates, pipe tools, and variety of machinists' tools and supplies, new and in good condition, will be sold low. Frank K. Tyler, Summerfield, Md.

For Sale — Valuable Manufacturing Property, centrally located in one of the largest Western States, with a well-established reputation for the goods of its manufacture, which consist of engines, boilers, saw and grist mill machinery, and kindred articles. Property all in first-class condition; tools and machinery in good order, and the works now running. Parties who mean business, and desire to engage in a profitable and well-established business of this character, can get full particulars by writing or applying in person to M. D. Wheeler, Stapleton, Staten Island, N. Y., or Manning, Maxwell & Moore, 111 and 113 Liberty st., New York.

BRADLEY'S UPRIGHT CUSHIONED HELVE HAMMER

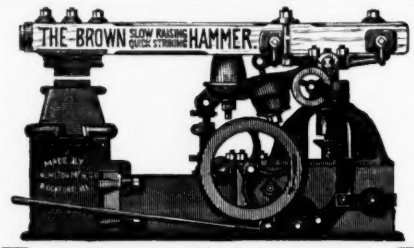
Combines all the best elements essential in a first-class Hammer. Has more good points, does more and better work and costs less for repairs than any other Hammer in the World.

BRADLEY & CO. Syracuse, N.Y.

BEAUDRY'S UPRIGHT CUSHIONED POWER HAMMER

The success of our machine is the best guarantee of its value. Only hammer with patent Duplex Steel Helve which never rattles, burns or breaks. Guaranteed to do more and better work with less repairs than any other.

BEAUDRY & CUNNINGHAM, Boston, Mass.



THE BROWN HAMMER STRIKES A BLOW WITH Double the Velocity That it Raises the Hammer. A NEW MOVEMENT! SEND FOR DESCRIPTION. ENOWLTON MFG. CO., KING ST., ROCKFORD, ILL.

STEPHENS PATENT VISES.

ONE-HALF TIME and LABOR saved by using this solid, strong, durable, firm-hold, quick-working Lever (Not Screw) Vise. Has improved Taper-Pipe and other attachments. Sold by the trade. Send for circular. TOWER & LYON, 95 Chambers Street, New York. Successors to MELVIN STEPHENS.

HODGE'S Universal Angle Union PATENTED.

Combining an elbow and union, and can be set at any angle at which it is desired to run the pipe.

Manufacturers & Wholesale Agents. ROLLSTONE MACHINE CO., 45 Water St., FITCHBURG, MASS.

OIL CUPS

For Engines, Shafting, &c. Illustrated Catalogue Free.

J. E. LONERGAN & CO. Philadelphia, Penna.

GEO. F. BLAKE MANF'G. CO.

BUILDERS OF EVERY VARIETY OF

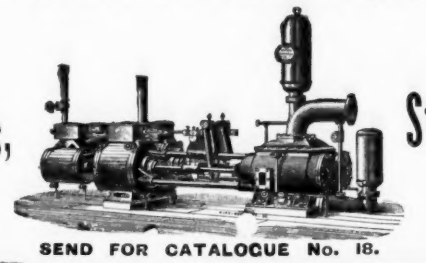
95 & 97 LIBERTY ST., NEW YORK. 44 WASHINGTON ST., BOSTON.

ENGINES A SPECIALTY

WATER WORKS PUMPING

THE DEANE STEAM PUMP CO., Holyoke, Mass.

BUILD Water Works, ENGINES AND Steam Pumping MACHINERY.



SEND FOR CATALOGUE No. 18.

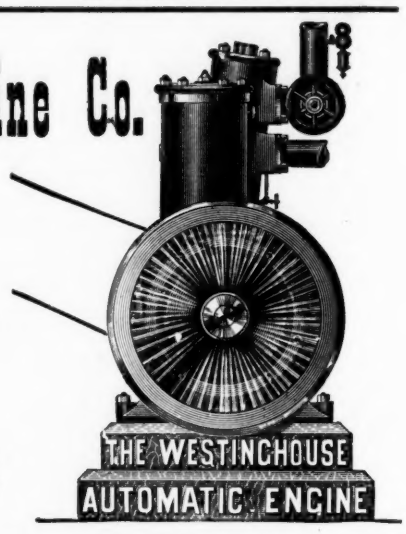
25-INCH PILLAR SHAPER.

This Machine has a stroke of 25 inches, cross-feed of 27 inches, and will plane work 20 inches high. It has a large vise, with extra jaws to hold irregular work, and a good, big solid table, that will stand the strain of a heavy cut. It has space under the cutter bar to run shaft 4 inches in diameter entirely through for keyseating, etc. A very important feature is the automatic, vertical and angular feed. Its value especially on large work will be appreciated. Send for Catalogue for full description.

THE HENDEY MACHINE CO. TORRINGTON, CONN.

THE **Westinghouse Machine Co.**

MANUFACTURERS OF THE WESTINGHOUSE AUTOMATIC ENGINE.



PRICES REDUCED.

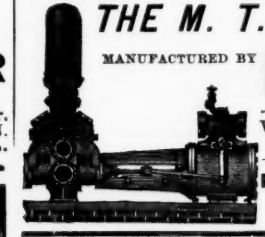
The Condemnation of Our Competitors is the Measure of Our Success.

SALES DEPARTMENT of the U. S. Conducted by WESTINGHOUSE, CHURCH, KERR & CO. 17 Cortlandt St., New York. | Hamilton Building, Pittsburgh, Pa.

FAIRBANKS, MORSE & CO., Chicago, Ill. | D. A. TOMPKINS & CO., Charlotte N. C.
FAIRBANKS & CO., St. Louis, Mo. | ROBERT MIDDLETON, Mobile, Ala
PARK & LACY, San Francisco, Cal | H. DUDLEY COLEMAN, New Orleans, La
UTAH & MONTANA MACH. CO., Salt Lake, Utah. KEATING IMPLEMENT & MACH. CO., Dallas, Tex. IRON BAY MFG. CO., Marquette, Mich

THE M. T. DAVIDSON IMPROVED STEAM PUMP,

MANUFACTURED BY **DAVIDSON STEAM PUMP COMPANY.**



WARRANTED THE **BEST PUMP** MADE FOR ALL SITUATIONS.

PRINCIPAL OFFICE, No. 77 LIBERTY STREET, N. Y.
NEW ENGLAND OFFICE, 51 OLIVER STREET, BOSTON, MASS.

SEBASTIAN, MAY & CO.'S Improved Screw Cutting FOOT or POWER LATHES.

Catalogue of Lathes, Drill Presses and Machinists Tools and Supplies mailed on application. *Lathes on Trial.* 167 W. Second St., CINCINNATI, O.

If you want an **ENGINE**

FOR ELECTRIC LIGHT OR ANY OTHER SERVICE.

For which an automatic is suitable. Read the article on 3d page of AMERICAN MACHINIST of February 12th, 1887 (Vol. 10, No. 7), and write to

COOKE & CO.

22 Courtlandt Street, New York.

Stating the size wanted and service required, and you will obtain lower prices for a **thoroughly first-class engine,** than you can get elsewhere.

VERTICAL BOILERS, 5 to 23 H. P. in stock.
—PRICES LOW.—

The Pump Catechism, &c.

THE PUMP CATECHISM. A practical help to RUNNERS, OWNERS and MAKERS of PUMPS of any kind. Covering the Theory and Practice of Designing, Constructing, Erecting, Connecting and Adjusting. By Robert Grimshaw, M. E. Profusely illustrated. 18mo, cloth.....$1 00

STEAM ENGINE CATECHISM. A Series of thoroughly practical questions and answers arranged so as to give to a young Engineer just the information required to fit him for properly running an engine. Fourth edition, enlarged. 18mo, cloth.....$1 00

STEAM ENGINE CATECHISM. Part II. Containing answers to further practical questions received since the issue of the first volume. 18mo. cloth.....$1 00.

JOHN WILEY & SONS,
15 Astor Place, New York.
Mailed and prepaid on the receipt of the price.

GUILD & GARRISON,
BROOKLYN, N. Y.
STEAM PUMPS,
VACUUM PUMPS,
AIR COMPRESSORS.
SEND FOR CATALOGUE.

SECOND-HAND PLANING MACHINE,
FOR SALE AT A BARGAIN.

This machine will plane 59 in. wide by 47 in. high by 20 feet long; the bed plate is 33 feet 5 in. long, the table is 21 feet 9 inches long, and the weight is estimated at 50,000 lbs.

BETTS MACHINE COMPANY,
MANUFACTURERS OF
Metal-Working Machine Tools,
WILMINGTON, DELAWARE.

NICHOLSON FILE CO. — SOLE MFRS. OF

FILE CARD.

Files and Rasps

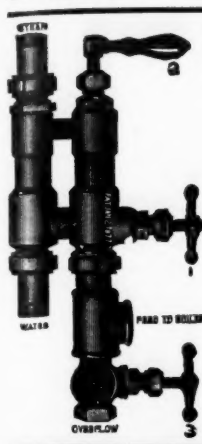
FILE BRUSH.

Having the Increment Cut.

The illustrations herewith presented, exhibit more convenient and durable forms of **File Cleaners** than are usually found, the majority of those in use being rudely devised and troublesome, and we believe for this reason, those of our manufacture will find a ready sale. Machinists and others who have not already given them a trial, will find it to their advantage to order the **File Card** and **File Brush** at once.

Manufactory and Office,

PROVIDENCE, R. I., U. S. A.



THE HANCOCK INSPIRATOR.

THE STANDARD

BOILER FEEDER FOR ALL CLASSES OF BOILERS.

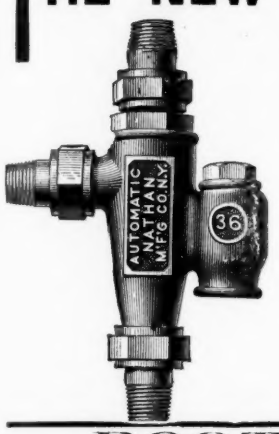
OVER 85,000 IN USE.

Send for Circulars and Price Lists.

THE HANCOCK INSPIRATOR CO.

OFFICE, 33 INDIA WHARF, BOSTON, MASS.

THE NEW "GRESHAM" PATENT



AUTOMATIC RE-STARTING INJECTOR

"Invaluable for use in Traction, Farm, Portable Marine and Stationary Boilers of all kinds. No handles required. Water supply very difficult to break. Capability of re-starting automatically, immediately after interruption to feed from any cause."

SEND FOR CATALOGUE. **RELIABLE AND CHEAP.**

Sole Manufacturers in the United States and Canada.

NATHAN MANUFACTURING CO.

92 & 94 LIBERTY ST., - - - NEW YORK.

ROOTS'

Force Blast Rotary Blower

FOR

FOUNDRIES, SMITH SHOPS, PNEUMATIC TUBES, VENTILATION, ETC.

SLOW SPEED,
POSITIVE BLAST,
PERFECTLY BALANCED,

Best Mechanical Construction.

P. H. & F. M. ROOTS, Manufacturers,
CONNERSVILLE, IND.

S. S. TOWNSEND, Gen. Agt. } 22 Cortlandt St.
COOKE & CO., Selling Agts. } NEW YORK.

In Writing, Please Mention This Paper.

L. S. STARRETT,
Manufacturer of
FINE TOOLS
ATHOL, MASS.
SEND FOR FULL LIST.

UNEQUALLED for STRENGTH, ACCURACY

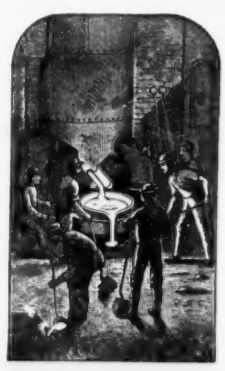
"THE SWEETLAND" CHUCK

M'F'R'D BY THE HOGGSON & PETTIS M'F'G CO.
EST. 1849
NEW HAVEN, CT.

DURABILITY and SIMPLICITY.

Send for 72 Page Catalogue.

P. BLAISDELL & CO.
Manufacturers of
Machinists' Tools,
WORCESTER, MASS.



T. SHRIVER & Co's

IRON FOUNDRY,

333

East 56th St.,

NEW YORK.

Contracts Solicited for Machinery Castings in regular supply.

BEMENT, MILES & CO.,

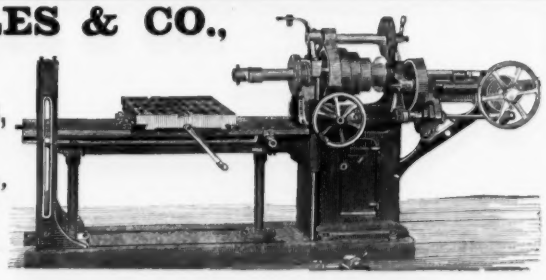
PHILADELPHIA, PA.,

BUILDERS OF

Metal-Working Machine Tools,

FOR

RAILROAD SHOPS,
Locomotive and Car Builders,
Machine Shops, Rolling Mills,
Steam Forges, Ship Yards,
Boiler Shops, Bridge Works,
Etc., Etc.

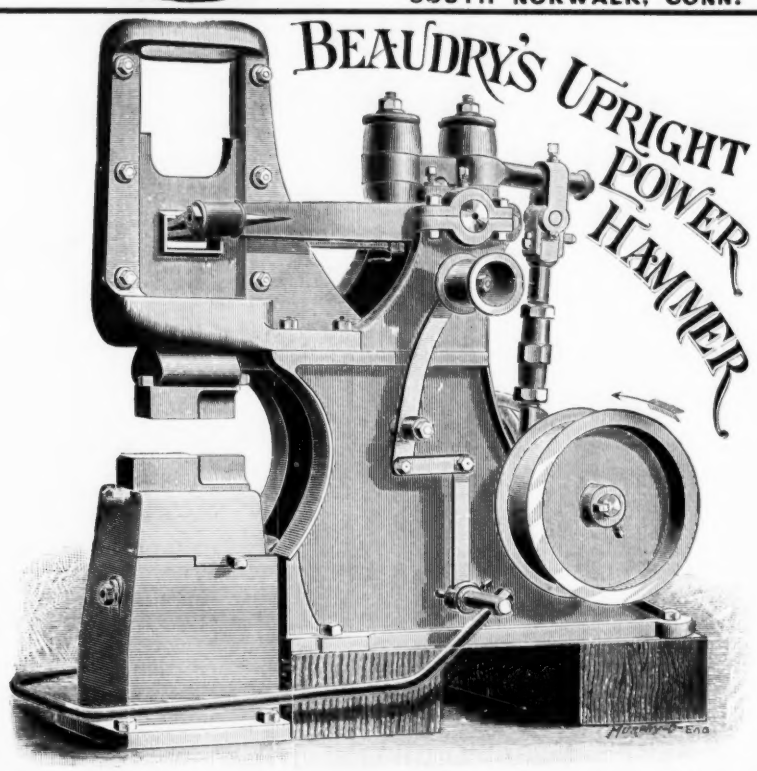


REDUCED PRICES OF LeCount's Light Steel Dog

No.	INCH.	PRICE.	No.	INCH.	PRICE.
1	5/8	$ .35	8	2	$1.10
2	1/2	.35	Small Set of 8-5.50		
3	3/4	.50	9	2 1/2	1.40
4	1	.60	10	3	1.50
5	1 1/4	.75	11	3 1/2	1.70
6	1 1/2	.85	12	4	1.90
7	1 3/4	1.00	Full Set of 12-12.00		

C. W. LECOUNT,
SOUTH NORWALK, CONN.

BEAUDRY'S UPRIGHT POWER HAMMER



We Book Orders Ahead

BUT

at this date, FEBRUARY 26th, can make

QUICK SHIPMENT

ON THE FOLLOWING SIZES:

25 LB., 75 LB., 100 LB., 125 LB.

These sizes are not necessarily in stock, but are nearing

IMMEDIATE COMPLETION.

BEAUDRY & CUNNINGHAM, BOSTON, MASS.

WALKER'S TOOL HOLDER.

For holding drills and reamers for lathe work. Prevents breaking or slipping. Can also be used for drilling and reaming holes by hand, and for reaming holes under drill presses, etc. Made with double handle, when required.

WALKER MFG. CO.,
CLEVELAND, OHIO.

WELDLESS STEEL TUBES — COLD DRAWN

QUICK OPENING GATE VALVE

SMOOTH INSIDE & OUT.

JOHN S. LENG.
4 Fletcher St N.Y.

Aluminium the "Metal of the Future."

The only Treatise in the English Language.

JUST READY.

Aluminium: Its History, Occurence, Properties, Metallurgy and Applications, including its Alloys. By Joseph W. Richards, A. C., Chemist and Practical Metallurgist. Member of the Deutsche Chemische Gesselischaft. Illustrated by 16 engravings, 12mo., 346 pages. *Price, $2.50, free of postage, to any address in the world.*

Contents: Part I. History of Aluminium. II. Occurrence of Aluminium in Nature. III. Physical Properties of Aluminium. IV. Chemical Properties of Aluminium. V. Metallurgy of Aluminium. VI. The manufacture of Sodium. VII. Manufacture of Alumina. VIII. Manufacture of Double Chloride of Aluminium and Sodium. IX. Manufacture of Aluminium at Salindres (Gard). X. Reduction of Aluminium by Other Reducing Agents than Sodium. XI. Working of Aluminium. XII. Alloys of Aluminium. Appendix. Addenda. Index.

A circular showing the full table of contents of this volume will be sent, free of postage, to any one in any part of the world who will furnish us with his address.

HENRY CAREY BAIRD & CO.,
Industrial Publishers, Booksellers and Importers,
810 Walnut St., Philadelphia, Pa., U. S. A.

---

38 and 40 Hawley St., Boston, Mass.

No. 0. GRINDING MACHINE, FOR LIGHT WORK, TOOL GRINDING, ETC. TAKES EMERY WHEEL TO 12 IN. IN DIAMETER. ¾" ARBOR, AND PEDESTAL ON WHICH TO MOUNT ANY OF OUR SMALLER GRINDING MACHINES IN ABSENCE OF BENCH ORDINARILY USED.

UNION STONE COMPANY,

WORTHINGTON

Independent Condensers

ARE NOW IN USE ON ENGINES AGGREGATING UPWARDS OF

50,000 HORSE POWER

One of these machines—**the largest Independent Condenser in the world**—is applied to an engine of

8,000 HORSE POWER

SEND FOR ILLUSTRATED CATALOGUE

HENRY R. WORTHINGTON
NEW YORK
BOSTON PHILADELPHIA
CHICAGO ST. LOUIS SAN FRANCISCO

SAFE ECONOMICAL DURABLE BOILERS

HARRISON SAFETY BOILER WORKS. PHILADELPHIA, PA.

MERITS PROVEN 20 YEARS RECORD

"STEAM" A VALUABLE BOOK for EVERY STEAM USER AND ENGINEER

PUBLISHED FOR FREE DISTRIBUTION, BY

THE BABCOCK & WILCOX CO.

Manufacturers of

WATER-TUBE BOILERS,

107 Hope St., GLASGOW. *30 Cortlandt St., NEW YORK.*

ROOT'S NEW WATER-TUBE STEAM BOILER

SAFE! ECONOMICAL! DURABLE!

For Illustrated Catalogue of New Boiler, Address

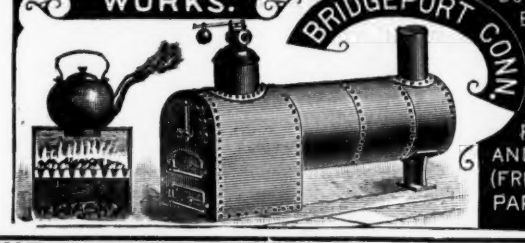
ABENDROTH & ROOT MANFG. CO.

—28 CLIFF STREET, NEW YORK.—

SELLING AGENTS,

A. B. ENSIGN, Clinton House, Rochester, New York.
A. S. FISKE, 41 Johnston Building, Cincinnati, Ohio.
WILLIAM H. SMITH, 115 Dearborn Street, Chicago, Ill.
VILLARS MERRILL, 149 N. 3d Street, Philadelphia, Pa.
WIGGS & BACON, Birmingham, Ala.
CHARLES E. ASHCROFT, 19 Mason Building, Boston, Mass.

BRIDGEPORT BOILER WORKS.



SEE THE IMPROVEMENTS IN STEAM BOILERS, BOILER FRONTS, BOILER FURNACES, AND FEED WATER HEATERS MADE AT THESE WORKS BEFORE BUYING STEAM PLANT. SEND FOR HISTORIES OF STEAM BOILERS AND FFED WATER HEATERS (FREE) ON MENTIONING THIS PAPER. WM. LOWE.

THE SKINNER ENGINE CO.

ERIE, PA.

PORTABLE AND STATIONARY

ENGINES and BOILERS

Send for Catalogue and Prices.

DISCOUNT TO CLUBS. WRITE FOR FULL LIST.

HARDENED

STEEL SQUARES

and other

Fine Tools,

Manufactured by

STANDARD TOOL CO.

ATHOL, MASS.

TO STEAM USERS:

MINERAL WOOL

Does not Char, Burn, Crack or Rot when applied on Cylinders, Pipes and Boilers to prevent loss by radiation. Sample and Circular free.

U. S. MINERAL WOOL CO., 22 Cortlandt St., N. Y.

CRANK PLANERS

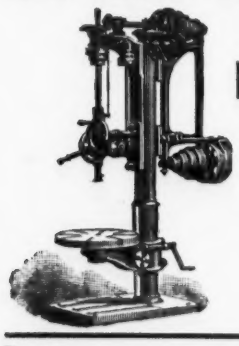
Superior Design & Workmanship, Extra Heavy (1500 lbs.)
DOWN, ANGULAR AND CROSS-FEED,
TO PLANE 12x16x15.
THE R. A. BELDEN CO., DANBURY, CT.

MARCUS RUTHENBURG

STEAM. HYDRAULICS. PNEUMATICS.

64 W. 3rd ST. CINCINNATI, OHIO.

NEW HAVEN MANUF'G CO.,



New Haven, Conn.

Lathes,
Planers,
Shapers,
Slotters,
Etc.

CHARLES MURRAY

ENGRAVER ON WOOD

58 ANN ST. NEW YORK.

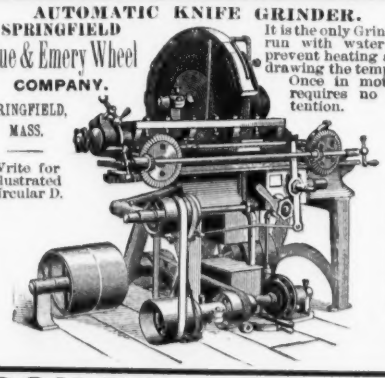
AUTOMATIC KNIFE GRINDER.

SPRINGFIELD Glue & Emery Wheel COMPANY.

SPRINGFIELD, MASS.

Write for Illustrated Circular D.

It is the only Grinder run with water to prevent heating and drawing the temper. Once in motion requires no attention.



Will ship on its merits.

Buffalo Cupola & Forge Blowers.

Warranted superior to any other make.

All sizes and styles of every class of work.

BUFFALO FORGE CO.

Buffalo, N. Y.

Send for Catalogue and prices.

BOILER SHELL DRILLING MACHINE. FOR MARINE WORK.

SEND FOR CUT AND DESCRIPTION.

THOS. H. DALLETT & CO.,

500 N. 13th St., PHILADELPHIA, PA.

A FAIR OFFER.

If you will put a JENKINS BROS. VALVE, on the worst place you can find, where you cannot keep other valves tight, and if it is not perfectly tight or does not hold Steam, Oils, Acids, or other fluids longer than any other Valve, you may return it, and your money will be refunded.

IF YOU WANT THE BEST, CALL FOR "JENKINS BROS." VALVES.

JENKINS BROS.,

71 John St. New York. 13 So. Fourth St., Phila. 105 Milk St., Boston.

WESTCOTT CHUCK CO., ONEIDA, N. Y.

FORMERLY ONEIDA STEAM ENGINE & FOUNDRY CO.

MANUFACTURERS OF

DRILL and LATHE CHUCKS

SEND FOR CATALOGUE.

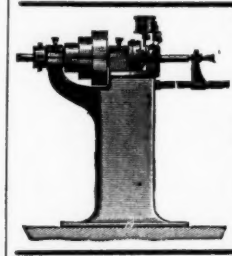
The United States Mitis Company,

26 BROADWAY, NEW YORK.

is prepared to issue licenses for the use of patents covering processes for the production of "Mitis Castings" in wrought iron and steel, and furnaces for melting and heating.

"Mitis" Castings retain in every respect all the valuable qualities of the wrought iron and steel (scrap) from which they are made. Do not require annealing. Can be welded and worked under the hammer as well as the raw material.

W. F. DURFEE, General Manager.



William Barker & Co.

Manufacturers of

IRON AND BRASS

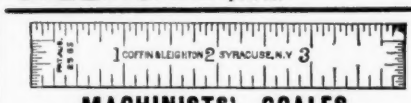
—WORKING—

MACHINERY

140 & 142 E. Sixth Street,

N'r Culvert, Cincinnati, O.

Send for circulars and prices.



MACHINISTS' SCALES,

Patent End Graduation.

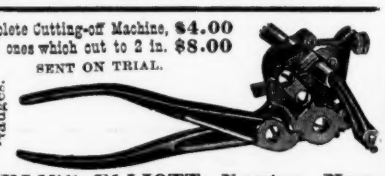
We invite comparison for accuracy with all others.

Every Scale Guaranteed. Send for List.

COFFIN & LEIGHTON, SYRACUSE, N. Y

A Complete Cutting-off Machine, $4.00
Larger ones which cut to 2 in. $8.00
SENT ON TRIAL.

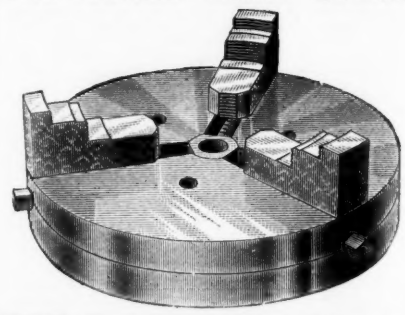
Drill Presses. Tap Drill Gauges.



STERLING ELLIOTT, Newton, Mass.

ESTABLISHED 1851.

The Horton Lathe Chuck.



THE E. HORTON & SON CO.

Canal St., Windsor Locks, Conn., U. S. A.

J. WENDELL COLE, M. E.

Manager of Pennsylvania Southern Lake regions and the Northwest for

DETROIT EMERY WHEEL CO.

Address, Box 84, Columbus, O., or P. O. Box 152 Chicago.

Hart's Corundum-Emery Wheels.

"CUSHMAN" CHUCKS

Are guaranteed to be right in all respects. Ask to see them at your dealers, or write direct to the factory. Respectfully,

THE CUSHMAN CHUCK CO.,

HARTFORD, CONN.

SHAPING MACHINES

For Hand and Power, 6", 8" and 10" Stroke.

Adapted to all Classes of Work to their capacity.

CIRCULARS FURNISHED.

BOYNTON & PLUMMER,

Worcester, Mass.

UNIVERSAL RADIAL AND RADIAL DRILLING MACHINES

THREE DESIGNS. SIX SIZES.

EMBODY ALL DESIRABLE FEATURES

PRICES $450.00 & UPWARD

ADDRESS UNIVERSAL RADIAL DRILL CO

CINCINNATI O U.S.A.

MACHINERY FOR THE

TRANSMISSION OF POWER

Shafting, Pulleys, Hangers, Gears.

LINK-BELTING & SPROCKET WHEELS.

LINK-BELT MACHINERY CO.

CHICAGO.

49 Dey St. N.Y. Minneapolis.

Burr & Dodge. 125 N. 5th St., Phila.

STANDARD PUNCHES FOR IRON & STEEL PLATES.

E P. B. SOUTHWORTH,

94 Exchange street, Rochester, New York.
Indicating Engineer and Mechanical Draftsman.
Correspondence solicited.

HOOPER'S 70% GRATE BAR.

Will not Warp.
Will not burn off at the ends.
Will give absolutely 70% air space.
Will give uniform combustion of fuel.

Send for Circular and Price List to

ALEXANDER TRAUD,

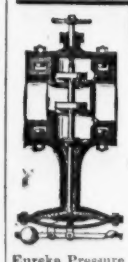
EAST FERRY STREET IRON WORKS,

NEWARK, N. J.

Established in 1874.

CLEVELAND TWIST DRILL CO.

24 and 26 West Street, Cleveland, O.
101 Chambers Street, New York.
85 Queen Victoria St., London, Eng.



Eureka Pressure Regulator.

Champion Return Steam Trap and Boiler Feeder.

Kieley's Patent for returning condensation to boilers from steam heaters of all kinds, Drying Cylinders, Evaporating Pans, Brewing Kettles, Paper Dryers, etc., whether above or below the boiler.

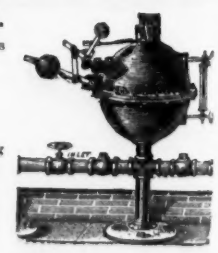
EUREKA PRESSURE REGULATOR,

for reducing the pressure on all kinds of Heating Apparatus, Drying Cylinders, Brewing Kettles, etc.

—SEND FOR CIRCULARS OF STEAM SPECIALTIES—

TIMOTHY KIELEY,

Nos. 7, 9 and 11 West 13th Street, - - New York.

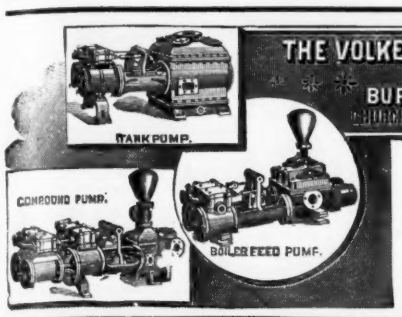


Champion Return Steam Trap.

Morse Twist Drill and Machine Company, New Bedford, Mass.

Manufacturers of **Morse Patent Straight-Lip Increase Twist Drills.**

SOLID AND SHELL REAMERS, BEACH'S PATENT SELF-CENTERING CHUCK, BIT STOCK DRILLS.
DRILL GRINDING MACHINES, MILLING CUTTERS AND SPECIAL TOOLS TO ORDER.

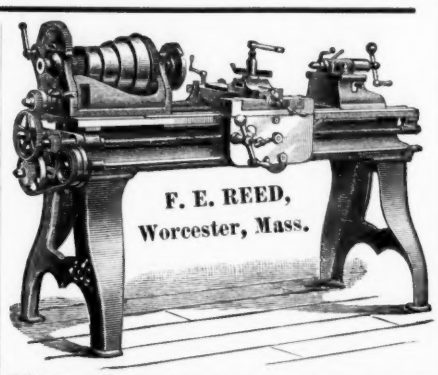


THE VOLKER & FELTHOUSEN MFG. CO.
MANUFACTURERS OF
BUFFALO DUPLEX STEAM PUMPS.
CHURCH, BIRD-ALL & MECHANIC STS. BUFFALO, N.Y.

For Sale at Factory Prices by

A. Aller, New York; S. C. Nightingale & Childs, Boston; Henry I. Snell, Philadelphia; Thos. J. Bell & Co., Cincinnati; Shaw, Kendall & Co., Toledo; Geo. Worthington & Co., Cleveland; N. O. Nelson Mfg. Co., St. Louis; Goulds & Austin, Chicago; C. E. Kennedy, Denver, Col.; Sheriff & Ashworth, Pittsburg, Pa.; Jos. Baur, Manistee, Mich.; Jas. Jenks & Co., Detroit, Mich.; Wickes Bros., East Saginaw; Adolf Leitelt, Grand Rapids; E. F. Osborne, St. Paul, Minn.; Kruse & Barker, Milwaukee, Wis.; Joshua Hendy Machine Works, San Francisco; Flynn & Emrich, Baltimore, Md.

BEVEL GEARS,
Cut Theoretically Correct.
For particulars and estimates apply to
BREHMER BROS.
Machinists,
440 N. 12th St., Philadelphia, Pa.



ENGINE Lathes, Hand Lathes, Foot Lathes, Upright Drills and Milling Machines. Agents, MANNING, MAXWELL & MOORE, 111 LIBERTY STREET, NEW YORK.

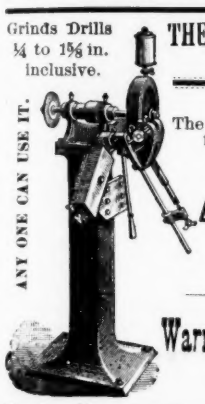
MACHINERY
For Reducing and Pointing Wire.

Especially Adapted to pointing wire rods and wire for drawing.

For Machines or information, address the manufacturer.

S. W. GOODYEAR Waterbury, Ct.

Grinds Drills ¼ to 1⅝ in. inclusive.



ANY ONE CAN USE IT.

THE HOUGH TWIST DRILL — GRINDER —

The SPECIAL CLAIMS made for this Tool are its

Simplicity,
Ease of Operation,
Low Price.

—MANUFACTURED BY—
Warner & Hough Machine Co.
ST. PAUL, MINN.

Manning, Maxwell & Moore, 111 Liberty St., New York. | Tallman & McFadden, 1025 Market St., Phila.

— OUR —
NEW CATALOGUE OF TOOLS
and Supplies sent free to any address on receipt of Ten Cents in stamps (for postage).
CHAS. A. STRELINGER & CO., Wood Ave., Detroit, Mich.

IRON AND STEEL **DROP FORGINGS**

Made to Order. **Low Prices.** *Good Workmanship.*

BRADLEY & PIERSON MFG. CO.,
Foot of CLAY STREET, - NEWARK, N. J.

STEEL BALLS
FOR ANTI-FRICTION BEARINGS,
OF BEST CAST STEEL.
HARDENED, GROUND & BURNISHED,
3-16" to 3" Diameter.
Samples and Prices on application.
SIMONDS ROLLING-MACHINE CO.,
FITCHBURG, MASS.

PATENT UNIVERSAL SCREW-CUTTING, CENTER, DEPTH ANGLE AND **TWIST DRILL GAUGE.**
J. WYKE & CO.
Fine Machinists' Tools, E, BOSTON, MASS. Send for Circular.

WHAT IS SAID OF
DIXON'S AMERICAN GRAPHITE
=ARTISTS' PENCILS=
MANUFACTURED BY
JOS. DIXON CRUCIBLE CO., Jersey City, N.J.

We find them equal to any we have yet used. PANCOAST & MAULE, Phila.

We find them generally satisfactory. THE YALE & TOWNE MFG. CO. Stamford, CONN.

*** It will pay every reader of this paper to send 16 cents in stamps to the JOSEPH DIXON CRUCIBLE CO., of Jersey City, N. J., for Samples. By mentioning this paper, they will receive Pencils worth double the money.

PECK'S PAT. DROP PRESS.
NEW HAVEN
BEECHER & PECK, CONN.

DROP FORGINGS OF IRON OR STEEL
BEECHER & PECK, NEW HAVEN CONN.

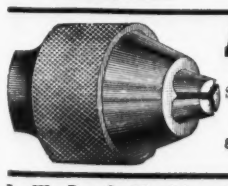
W. C. YOUNG & CO., Worcester, Mass.
Manufacturers of
Engine Lathes, Hand Lathes,
FOOT POWER LATHES, SLIDE RESTS, Etc.

J. A. FAY & CO. CINCINNATI, OHIO, U.S.A.
BUILDERS OF IMPROVED
WOOD-WORKING MACHINERY

Embraces nearly 400 Machines for
PLANING & MATCHING
Surfacing, Moulding, Tenoning, Mortising, Boring, and Shaping, etc.

Variety and Universal
WOOD WORKERS.
Band, Scroll and Circular Saws, Resawing Machines, Spoke and Wheel Machinery, Shafting, Pulleys, etc. All of the highest standard of excellence.

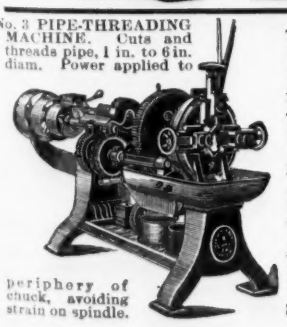
W. H. DOANE, Pres't. D. L. LYON, Sec'y



Almond Drill Chuck
Sold at all Machinists' Supply Stores.
T. R. ALMOND,
83 & 85 Washington St., Brooklyn, N. Y.

L. W. Pond Machine Co.
Manufacturers of and Dealers in
IRON WORKING MACHINERY.
Iron Planers
A Specialty.
140 Union St.
Worcester, MASS.

No. 3 PIPE-THREADING MACHINE. Cuts and threads pipe, 1 in. to 6 in. diam. Power applied to periphery of chuck, avoiding strain on spindle.



No gearing changed in regulating speeds. Also made with steam engine attachment when desired.

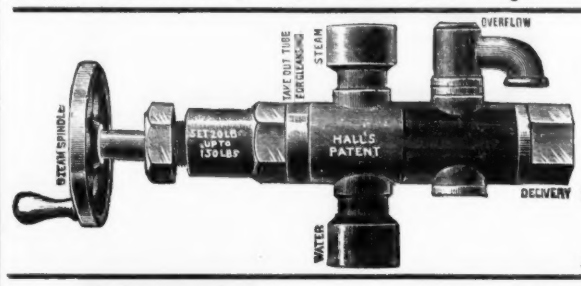
THE EATON, COLE & BURNHAM CO.
82 & 84 Fulton Street, New York,
MANUFACTURERS OF
PIPE CUTTING and THREADING MACHINES
OPERATED BY HAND OR POWER.
FITTINGS, VALVES, PIPE, PIPE TOOLS,
AND ALL STYLES OF IRON AND BRASS GOODS FOR
STEAM, WATER AND GAS.
Factory, Bridgeport, Conn.

D. SAUNDERS' SONS, Yonkers, N.Y.
MANUFACTURERS OF

Steam and Gas Fitters' Hand Tools.
SEND FOR CIRCULAR.

Pipe Cutting, THREADING, AND Tapping Machines.

THE PATENT WHEEL PIPE CUTTER shown in the cut combines simplicity with strength and lightness. Easily adapted to various sizes of pipe. Rolling instead of sliding motion. No loose parts to become detached and mislaid. All wearing surfaces are of tool steel, hardened. Less friction of parts than any other pipe-cutter made.



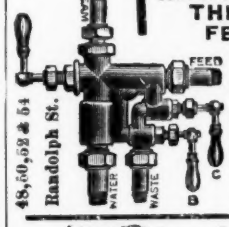
HALL'S
Patent Automatic
INJECTORS.
SIMPLE and RELIABLE.
2 Lbs. to 150 Lbs. Steam.
20,000 NOW WORKING.
Hall's Engineering Co.
112 John St., . . New York

STEEL CASTINGS

From 1-4 TO 15,000 lbs. WEIGHT.
True to Pattern, sound, solid, free from blow-holes and of unequaled strength.
Stronger and more durable than iron forgings in any position or for any service whatever.
40,000 CRANK SHAFTS and 30,000 GEAR WHEELS of this steel now running prove this.
Cross-Heads, Rockers, Piston-Heads, etc., for Locomotives.
STEEL CASTINGS of every description.
Send for Circulars and Prices to
CHESTER STEEL CASTINGS CO.,
Works, Chester, Pa. Office, 407 Library St., Philadelphia, Pa.

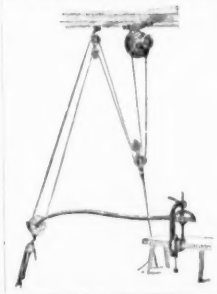
TRAUTWINE'S
CIVIL ENGINEER'S POCKET-BOOK.
"Beyond all question THE BEST practical manual for the engineer that has ever appeared."—GEORGE L. VOSE, C. E., in "Manual for Railroad Engineers."
RAILROAD CURVES. EARTHWORK, Measurement and cost of.
JOHN WILEY & SONS, NEW YORK. E. & F. N. SPON, LONDON.

Christiana Machine Co., Christiana, Pa.,
Manufacture Shafting, Pulleys, Hangers, Gearing, Steam Engines and Turbine Water Wheels. Special attention to furnishing Castings to the trade. Philadelphia office, 206 N. Fourth street.

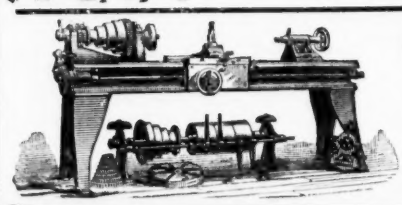


THE DUPLEX INJECTOR
THE BEST BOILER FEEDER KNOWN.
Not liable to get out of order. Will lift water 25 feet. Always delivers water *hot* to the boiler. Will start when it is hot. Will feed water through a heater. Manufactured and for sale by
JAMES JENKS & CO.
Detroit, Mich.

STOW MANFG. CO., Binghamton, N. Y.



FLEXIBLE SHAFTS,
TAPPING and REAMING MACHINES,
Portable Drills,
ALSO FLEXIBLE BORING MACHINES
For Ironing Carriages and Wagons; Boring for Pinning Sash, Doors and Blinds, also for Stair Work.



16 in. and 18 in. **ENGINE LATHES.**
New Designs. Low Prices.
THE MULLER MACHINE TOOL CO.
182 W. Pearl St., CINCINNATI, O.

FRICTION
CLUTCH PULLEYS AND CUT-OFF COUPLINGS.
JAS. HUNTER & SON,
North Adams, Mass.

The Armstrong Mfg. Co.
BRIDGEPORT, CONN.
Water, GAS AND STEAM Fitters' Tools.

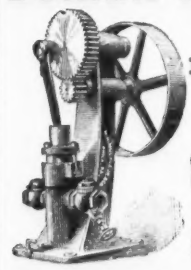
STOCKS, AND DIES FOR PIPE, BOLTS AND BRASS PIPE WRENCHES, PIPE VISES, ETC.
—— SEND FOR CATALOGUE. ——

"You Cannot Know"

Until you have tried it, what you may save in time and money by using the AMERICAN UNION for all kinds of Pipe Fitting. Many Live Jobbers in Fitters' Supplies keep these Unions in stock; many furnish them when ordered; some, however, have not yet waked up to them. If you happen to deal with one of the latter sort, please write direct to us for Circular of the "American Union."

PANCOAST & MAULE,
PHILADELPHIA.

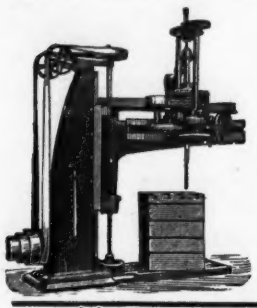
BOILER FEED PUMP



MADE BY
M. R. MUCKLE, Jr. & CO.
PHILADELPHIA.
SIZES TO SUIT STEAM PLANTS, UP TO 300 H. P.
Send For CirculaR.

S. ASHTON HAND MFG. CO.,
Toughkenamon, Chester Co., Pa.
MAKERS OF FIRST-CLASS
ENGINE LATHES
Are now in position to put on the market
14" ENGINE LATHES OF NEW DESIGN,
guaranteed to be equal in material, design and workmanship to the best ever offered.

FIRE SPRINKLERS
Should always have their pumps equipped with the
Mason Pressure Regulator,
which cannot stick. All goods warranted
Address MASON REGULATOR CO.
22 Central Street, Boston, Mass.



WILLIAM SELLERS & CO. INCORPORATED.

Engineers and Manufacturers of

IMPROVED MACHINE TOOLS FOR WORKING IRON AND STEEL

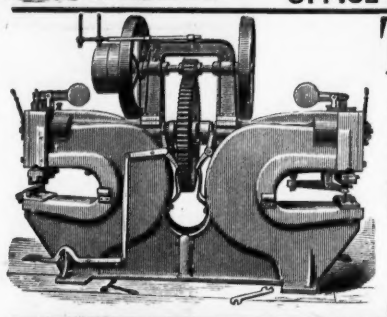
STEAM HAMMERS, PUNCHES and SHEARS, LATHES, PLANERS, BENDING ROLLS, BORING and TURNING MILLS, DRILL and TOOL GRINDERS, Etc., Etc.

SHAFTING, PULLEYS, HANGERS, COUPLINGS, Etc.

Improved Injectors for Feeding Boilers.

PAMPHLETS, PHOTOTYPES AND PRICES FURNISHED ON APPLICATION TO

OFFICE AND WORKS, PHILADELPHIA, PENN.



THE LONG & ALLSTATTER CO. Hamilton, OHIO.

Double, Single, Angle-Bar, Gang, Horizontal, Twin, Boiler, Spacing, Gate, Multiple, Belt and Steam-Driven

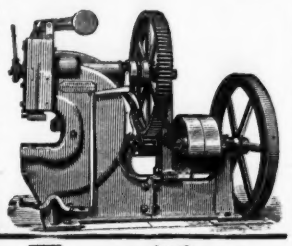
Punches and Shears.

Over 300 Sizes.

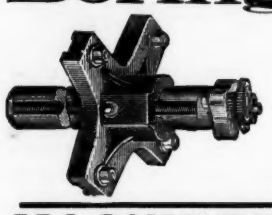
ALSO,

Power Cushioned Hammer.

Send for new Catalogue.



Boring Bar for Lathe.



BUILT ANY SIZE REQUIRED.

HAS HARDENED STEEL CENTERS, CONSTANT FEED OF CUT GEARS, STEEL FEED SCREW AND NUT, ACCURATELY GROUND, FIRST CLASS LATHE TOOL.

PEDRICK & AYER.

PHILADELPHIA, PA.

MACHINERY, TOOLS and SUPPLIES.

Complete Outfits for

MACHINISTS, BLACKSMITHS, MODEL MAKERS, JEWELERS, ETC.

Lathes, Planers, Shapers, Drill Presses, Emery Grinders, Milling Machines, Bolts, Screws, Washers, Belting, Packing, Waste, Twist Drills, Taps, Reamers, Cold Rolled Shafting, Hangers, Files.

SEND FOR ILLUSTRATED PRICE LIST OF METAL-WORKERS' TOOLS, ALSO WOOD-WORKERS'.

TALLMAN & McFADDEN, 1025 MARKET STREET, PHILADELPHIA.

THE

Slate Sensitive Drill

Adapted to rapid work with small drills. Its extreme sensitiveness prevents clogging and breakage of drills. Has a switching table with attachment for center drilling. Instantly adjustable to different lengths of work. Over 200 already in use. Send for circular.

DWIGHT SLATE,

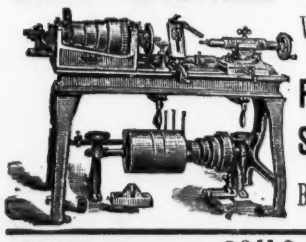
HARTFORD, - - CONN.

VOLNEY W. MASON & CO.,

Friction Pulleys, Clutches and Elevators,

PROVIDENCE, R. I.

GAGE MACHINE WORKS,



Waterford, N. Y

Manuf'r's of

Fox, Turret AND Speed Lathes AND Brass Finishers' TOOLS.

COILS & BENDS

—OF—

IRON, BRASS and COPPER

PIPE.

ALL STYLES.

THE NATIONAL Pipe Bending Co.

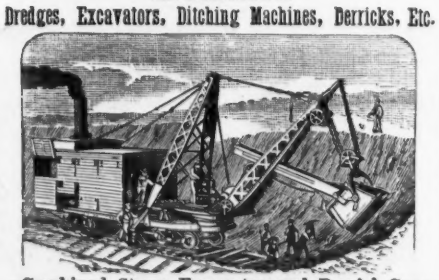
NEW HAVEN, CONN.

OSGOOD DREDGE CO., ALBANY, N. Y.

RALPH B. OSGOOD, Pres. JAMES H. BLESSING, Vice-Pres. JOHN K. HOWE, Secretary and Treasurer.

MANUFACTURERS OF

Dredges, Excavators, Ditching Machines, Derricks, Etc.



—Combined Steam Excavator and Derrick Car.—

HYDROSTATIC MACHINERY,

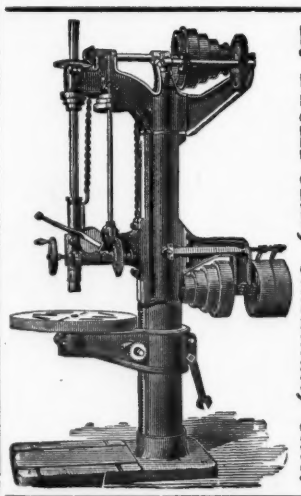
PRESSES, PUMPS, PUNCHES,

ACCUMULATORS,

JACKS, VALVES, FITTINGS,

VAULT ELEVATORS, &c., &c.

WATSON & STILLMAN, 204-210 East 43d St., N. Y.



UPRIGHT DRILLS

A SPECIALTY,

ALL SIZES WITH PATENT QUICK RETURN-FEED AND ALL MODERN IMPROVEMENTS,

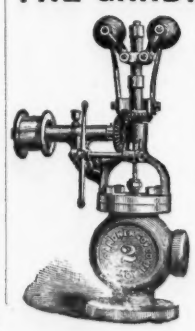
H. BICKFORD, Cincinnati, Ohio.

FRICTION CLUTCH PULLEYS,

HOISTING ENGINES, ELEVATORS, STEAM AND BELT POWER.

D. FRISBIE & CO., 112 Liberty St., N. Y.

THE GARDNER GOVERNOR



Over 45,000 in Use.

ADAPTED TO EVERY STYLE OF STATIONARY AND PORTABLE STEAM ENGINE.

Warranted to give satisfaction or no sale.

FOR CIRCULARS AND PRICES, ADDRESS

The Gardner Governor Co.

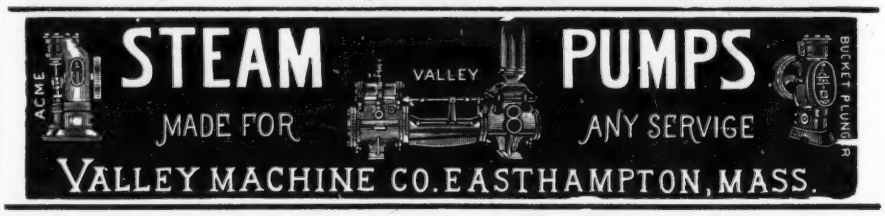
QUINCY, ILL.

SOUTHWARK FOUNDRY & MACHINE CO.

PHILADELPHIA, PA.

General Machinists, Founders and Boiler Makers,

Heavy Machinery of all Kinds a Specialty.



Pipe Cutting & Threading Machines

FORBES & CURTIS, Bridgeport, Ct.

WHY THIS IS PUT HERE!

For the reason that if you are interested in raising water or other liquids by steam power, we wish to call your attention to the

NEW PULSOMETER,

THE CHEAPEST AND BEST STEAM PUMP IN THE MARKET. PRICES LOWER THAN ANY OTHER.

More Efficient, Simple, Durable, and more Economical, both as to running expenses and repairs, than any other Steam Pump.

Call or write for our new 96 page Illustrated Descriptive Book containing Full Particulars, Reduced Net Prices, and hundreds of A-1 Testimonials. Mailed Free.

PULSOMETER STEAM PUMP CO., 83 JOHN STREET, N. Y.

Selden's Patent Packings

Recommended by Leading Engineers for Steam and Hydraulic Use.

Made either *with* or *without Rubber Core.*

Randolph Brandt, 38 Cortlandt St., N. Y.

SMITH PAPER CO.,

Manufacturers of Book, News and Manila Paper,

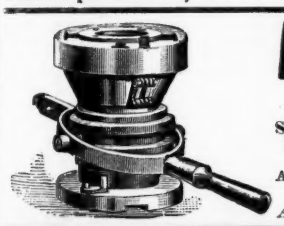
LEE, MASS.

Sir:

Your esteemed favor of 2d is at hand. As to the Selden's Round Packing, the best testimonial as to its value, in our estimation, is to be found in the fact of the long continued and large purchases of it which we have made. We consider it the best thing of its kind we have so far tried.

Yours,

SMITH PAPER CO.



ACME MACHINERY CO.,

CLEVELAND, OHIO.

Manufacturers of

"ACME"

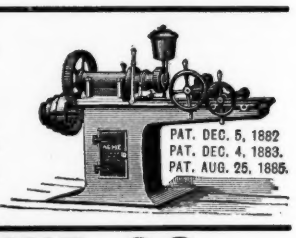
Single & Double Automatic Boltcutters,

cutting from 3-8 in. to 6 in. diameter,

Also SEPARATE HEADS AND DIES.

Send for Catalogue and Discounts.

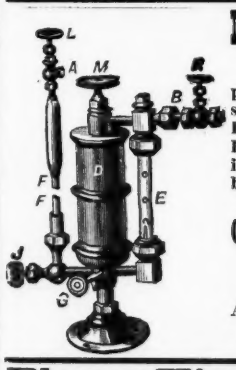
Agents, Manning, Maxwell & Moore, New York.



REMINGTON MACHINE CO.,

WILMINGTON, DEL.

Builders of CORLISS ENGINES, also BOILER MAKERS.



Lubricate Your Engine CYLINDERS

perfectly, gain power and save oil by using our Patent Automatic Sight Feed Lubricators, showing oil as it enters, drop by drop.

THE SEIBERT Cylinder Oil Cup Co.

BOSTON, MASS.

H. A. ROGERS, Agent for New York, 19 John Street, NEW YORK.

Planer Vises, 9 Sizes.

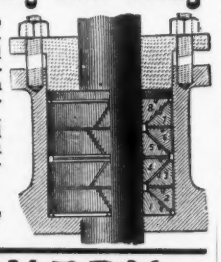
SPECIAL MACHINERY DESIGNED AND BUILT.

The Gilkerson Machine Works,

Write us. HOMER, N. Y.

Katzenstein's Self-Acting Metal Packing

For Piston Rods, Valve Stems, etc., of Steam Engines, Pumps, etc., adopted and in use by leading engine builders, mills, iron works and steamship companies all over the world. Also flexible tubular metal packing for slip joints on steam pipes, and for hydraulic pressure.



L. Katzenstein & Co.,

357 WEST STREET, N. Y.

MACHINERY.

New and Second Hand at great bargains.

Two	16″	swing,	6′	bed,	Engine Lathes (Porter), new.
One	17″	"	8′	"	" (Wright), "
"	24″	"	12′	"	" "
"	18″	"	8′	"	" second hand.
"	22″x22″x		5′	Pond Planer,	"
"	30	Swing Upright Drill (More&Wyman)"			
"	50	H. P. Stationary Engine			14″x30″ Cyl., new.
"	40	"	"	"	12″x30″ " "
"	30	"	"	"	10″x20″ " "
"	35	"	Center Crank	"	11′ x15′ " "
"	25	"	"	"	10″x12″ " "
"	20	"	"	"	9″x16″ "sd. hd.
"	20	"	"	"	9″x12″ " "
"	30	"	Portable	"	10″x16′ " new.
"	20	"	"	"	9″x12″ " "
"	15	"	"	"	8″x12″ " "

Also large stock of new and second hand Engines and Boilers. Correspondence solicited.

S. L. HOLT & CO.,

67 SUDBURY STREET, BOSTON, MASS.

Barnes' Pat. Upright Drills

20-inch Swing, with both Worm and Lever Feed.

Barnes' Pat Engine Lathe

15-inch swing, 6-foot or 8-foot Bed. These machines are made a specialty in our factory; they have advantages not found in other machines in this line. It will pay parties desiring to purchase, or know more about this class of machines, to send for full description and prices.

W. F. & JOHN BARNES CO.

1995 Main St., *Rockford, Ill.*

FOR SALE AT BARGAINS.

1 35 H. P. Hartupee Compound Engine, Band Wheel 6 ft. 8 in. Dia. x 16 in. face. Price $150.00

1 35 H. P. Engine. Flat Valve, Side Draft, New, without Wheels. Cylinder 12 x 20. $200.00

1 25 H. P. Engine, Cylinder 10 x 12, Center Crank. Rotary Valve. Link Motion, with Pump. $150.00

1 25 H. P. Engine, Cylinder 10 x 12, Flat Valve, Center Crank, with Pump. $150.00.

1 20 H. P Portable Engine and Boiler on skids. Cylinder 9 x 12, Flat Valve, Governor & Pump. $275.00.

1 Double Engine, Cylinders 6 x 8, Link Motion Center Crank. $150.00.

1 20 H. P. Engine, Cylinder 9 x 12, Flat Valve. Center Crank, with Pump. $140.00.

1 20 H. P. Engine, Cylinder 9 x 12, Rotary Valve, Center Crank, with Pump $130.00.

1 20 H. P. Engine, Cylinder 9½ x 12, Piston Valve, Link Motion, Center Crank, with Pump. $130.00.

1 15 H. P. Engine, Cylinder 8 x 12, Rotary Valve, Center Crank, with Pump. $75.00.

2 10 H. P Engines, Cylinder 7 x 12, Flat Valve, Side Draft. $65.00.

1 8 H. P. Engine, Cylinder 6 x 12, Rotary Valve, Side Draft. $60.00.

1 Engine Lathe, 18 in. Swing take in between Centres 4 ft., with 12 Horton Chuck. $60.00.

Lot small Machinists' Tools, Tap Dies, &c. The above Engines all have Band and Fly Wheel, except the 12 x 20.

CAMPBELL & MURPHY,

Millerstown, Pa. P. O., Barnhart Mills, Pa.

SECOND-HAND TOOLS FOR SALE

BY

POOLE & HUNT, Baltimore, Md.

1 Planing Machine. Will plane 35 in. wide, 27 in. high, and 16 ft. in. long.

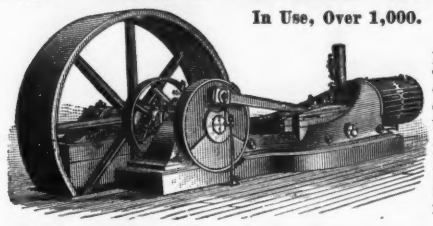
1 Planing Machine. Will plane 30 in. wide, 26 in. high, and 5 ft. 6 in. long.

1 Planing Machine. Will plane 24 in. wide, 22 in. high, and 5 ft. long.

1 Double Geared Chasing Lathe. Will swing 24 in. dia., 8 ft. 6 in. long.

1 Drill Grinding Machine. Made by Wm. Sellers & Co.

NEW TANGYE BUCKEYE AUTOMATIC CUT-OFF ENGINES.



In Use, Over 1,000. 25 to 1,000 H. P.

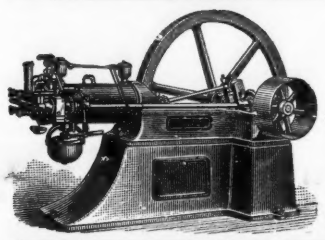
These Engines are the combined result of long experience with automatic cut-off regulation, and most careful revision of all details They are designed and constructed for heavy and continuous duty at medium or high rotative speeds. Highest attainable Economy in Steam Consumption and superior regulation guaranteed. Self-contained Automatic Cut-off Engines 12 to 100 H. P. for driving Dynamo Machines *a specialty*. Illustrated Circulars, with various data as to practical Steam Engine construction and performance, free by mail. Address, BUCKEYE ENGINE CO., Salem, Ohio.

SALES AGENTS: W. L. SIMPSON, 70 Astor House, N. Y. { N. W. ROBINSON, cor. Clinton & Jackson Sts., Chicago, Ill. ROBINSON & CARY, St. Paul, Minn.

KENSINGTON ENGINE WORKS, LIMITED, PHILADELPHIA,

Sole Licensees and Manufacturers for New Jersey (South of Trenton), Eastern Pennsylvania, Delaware, Maryland and Virginia.

"OTTO" GAS ENGINE WORKS.



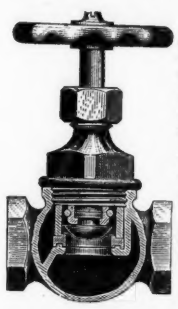
SCHLEICHER, SCHUMM & CO.,

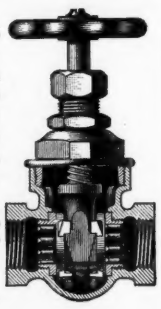
33d and Walnut Sts. PHILADELPHIA. Branch Office, 130 Washington St. CHICAGO.

OVER 20,000 ENGINES IN USE.

GUARANTEED To Consume 25 to 75 Per Cent. Less Gas than ANY Other Gas Engine doing the same work.

BLESSING'S RENEWABLE-SEAT GLOBE, STRAIGHTWAY and CHECK VALVES





The renewable Seats and Disks are cast from the best Phosphor Bronze Metal, which has lasting qualities, double that of the best Steam Metal commonly used in first-class valves. The Seats are simply dropped into place and held in position by bottom of cage, except in the Straightway Valves, in which they are screwed to place by the use of a special wrench furnished with each valve. These valves are equally applicable to steam, water, or other fluid pressure.

We also manufacture **Blessing's Albany Steam Traps, Blessing's Water Circulator and Purifier, and Blessing's Pump Governor.** Send for circular.

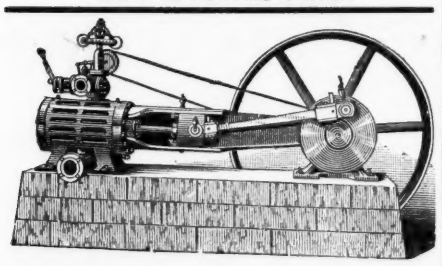
ALBANY STEAM TRAP CO., Albany, N. Y.

PORTER-HAMILTON ENGINE.

FOR HEAVY WORK AND LARGE POWERS. EXTRA HEAVY DESIGN.

Send for Catalogue.

WILLIAM TOD & CO., YOUNGSTOWN, OHIO.



STEARNS MFG. COMPANY,

ERIE, PA.

Engines from 15 to 400 Horse Power.

Boilers of Steel and Iron supplied to the trade or the user. Send for Catalogues.

SAW MILLS and GENERAL MACHINERY.

Works at ERIE, PA.

ECONOMICAL STEAM BOILERS

A SPECIALTY.

SEND FOR PRICES. Pond Engineering Co. ST. LOUIS, MO.

MACHINERY,

NEW AND SECOND-HAND.

12 in. S., 5 ft. Bed Engine Lathe, New
13 in. x 6 ft. Bed Engine Lathe, Ames, new.
14 " 7 ft. Bed Engine Lathe, Bogert new
15 " 6 ft. " " " Pratt & Whitney.
17 " 6 ft. " " " Putnam, not screw cutting
17 " 6', 7' " " Hewes & Phillips.
19 " 12,14" " " Pond, nearly new.
20 in. x 6 ft. Engine Lathe Putnam, good order.
20 in. x 10 ft. Engine Lathe, Harris, cheap.
24 " 10-12-14 and 20 ft. Ames, new.
29 " 12 ft " " " Harrisburg.
30 in. x 12 ft, Engine Lathe, New Haven.
34 " 12 ft. " " " Harrisburg, good.
42 in. x 16 ft. Engine Lathe, Ames, New.
16x6 ft. Turret Fox Lathe with chasing bar, new.
14 in.-20 in. and 33 in. Turret Head Chucking or Screw Machines, Bridgeport.
20-23 in., 25 in. and 28 in. Drills, Blaisdell, new.
20 in. Drill, Prentice.
20 " " Davis.
No. 1 and 2 Slate's Sensitive Drill.
Elliott Drill. Gang Drill.

SHAPERS.

15 & 24 in. Wolcott. 12 in Sellers.
20 in. Bridgeport

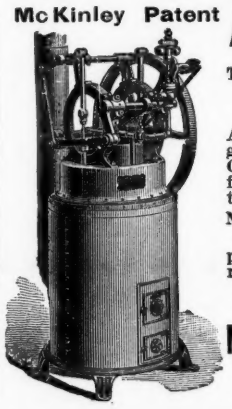
PLANERS.

16x42 in. Bridgeport. 24 in. x 6 ft. Hendey, New.
24 in x 6 ft., Powell. 24 in x 8 ft. Ames.
26 in. x 6&8 ft., " 22 in x 4 ft., 5 ft. and 6 ft. Powell.
30 in. x 10 ft. Hendey, New.
36 in. Squaring Shear, power, nearly new.
No. 3½ and 5 Press, Stiles
Lot of miscellaneous Machinery If you do not see what you want, write and state what is required.

E. P. BULLARD, 14 Dey St., New York.

McKinley Patent

Air Engine.



The Best and Cheapest on the Market.

No Steam. No Water. Absolute Safety. No Engineer. No pumps. No Gauges. No liability to freeze up. No Regulation required.

NO EXTRA INSURANCE.

Can be used for any purpose where power is required.

Cheap Fuel. Cheap First Cost.

McKinley Engine Co.
17 Broadway,
CINCINNATI, O.

To Buyers of Engine Lathes

We are now making from entirely new designs, *extra heavy* 19" and 21" Engine Lathes (the most popular sizes), of which we are making a specialty, and manufacturing in lots of not less than 100 at a time.

We make no charge for extras. Every lathe is furnished with *hollow spindle*; the 19" with 1⅛" hole, and 21' with 1⅜" hole. Every lathe has substantial *compound rest*, heavy tool post (bar steel), rest to turn full swing, *following rest* with adjustable jaws to take any size from 2½" down, with extra tool for shafting.

Full set of gears to cut from 2 to 18 threads including 11½ pipe thread. *Automatic stop on carriage. Separate screw and rod feed*, and the most substantial and easily managed *taper attachment* made. Cones and gears of large diameter and wide belt. Studs, screws and small gears are *steel or gun metal*. Webbed live heads, heavy tail stocks. No worm or worm gears, no weak reverse plate. *Perfect lubrication for all running parts*, including carriage.

Lead screw inside of shear, double nut (cut from solid), and taking hold of carriage directly under the line of strain. Friction counter-shaft, the most durable made. Our prices are reasonable for cash, and from which no deviation will be made. Our written guarantee accompanies every lathe.

GUARANTEE.

We guarantee this lathe to be equal in workmanship, truth, accuracy, solidity, material and finish, to the best made, and hold ourselves legally liable for this guarantee.

LODGE, DAVIS & CO.

MANUFACTURERS

Machine Tools,

159, 161, 163 and 165 EGGLESTON AVE.,
136, 138, 146, 148, 150, 152, 154 E. 6th St.

CINCINNATI, OHIO.

The Watts, Campbell Co.

NEWARK, N. J.

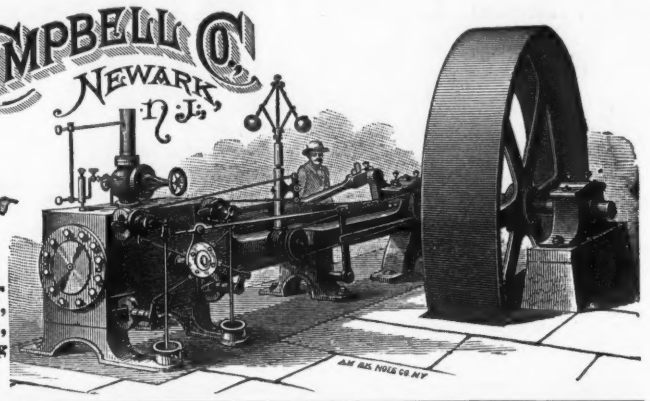
MANUFACTURERS OF IMPROVED CORLISS STEAM ENGINES IN FULL VARIETY.

Sizes Varying From

30 to 2000 Horse Power.

Horizontal or Vertical, Direct Acting or Beam, Condensing, Non-Condensing or Compound.

Send for Circular.



HEWES & PHILLIPS Iron Works.

IMPROVED

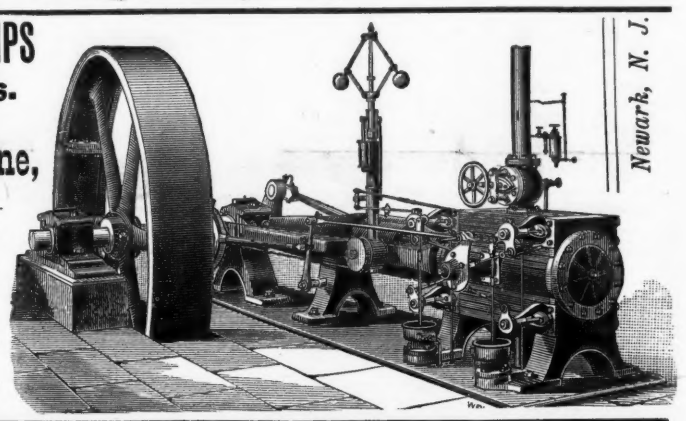
Corliss Engine,

High Pressure, —Condensing— And Compound

Send for Circular.

AGENT

Geo. A. Barnard
(175 Temple Court)
7 Beekman Street,
NEW YORK.

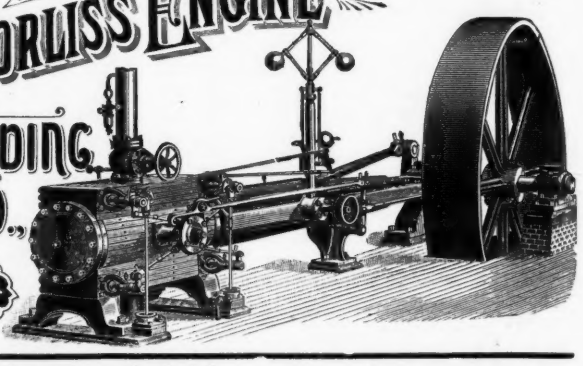


Newark, N. J.

THE IMPROVED FISHKILL CORLISS ENGINE

BUILT BY THE FISHKILL LANDING MACHINE CO.,

FISHKILL ON THE HUDSON, N.Y.



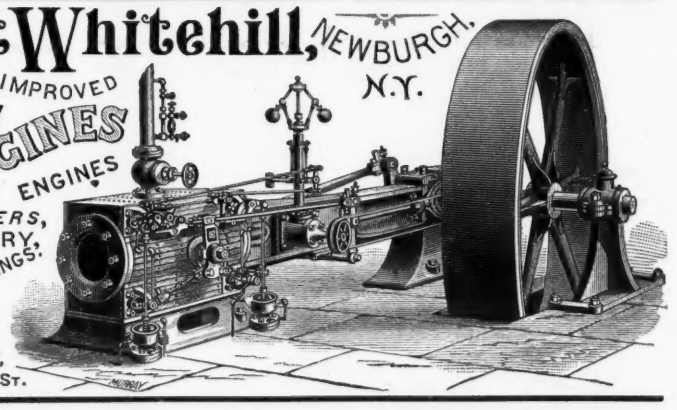
Robert Whitehill, NEWBURGH, N.Y.

MANUFACTURER OF IMPROVED CORLISS ENGINES

ALSO SLIDE VALVE ENGINES

STATIONARY BOILERS, GENERAL MACHINERY, IRON AND BRASS CASTINGS.

NEW YORK OFFICE Room 6, COAL AND IRON EXCHANGE, COR. CORTLANDT & CHURCH ST.



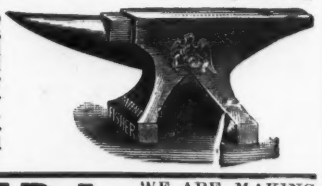
EAGLE ANVIL WORKS,

Trenton, N. J.

The Fisher Double Screw Leg Vise.—Warranted stronger grip than any other Vise. Always parallel and cannot be broken.

Send for Circulars.

The Eagle Anvil.—Best Cast Steel Face & Steel Horn. Better than any English anvil. Fully warranted and lower price.



EXTRA HEAVY LATHE

WE ARE MAKING A SPECIALTY OF A 24-INCH LATHE, WITH BED ANY LENGTH DESIRED. THIS LATHE IS DESIGNED FOR SEVERE SERVICE; IT IS THE HEAVIEST OF ITS SIZE EVER PRODUCED, AND THE WORKMANSHIP AS GOOD AS SKILL CAN MAKE IT.

SEND FOR CIRCULAR.

S. S. HEPWORTH & CO., "Glenwood Station," Yonkers, N. Y.

Acme Bolt Cutter "OUR BEST."

Single and Double Bolt Cutters Cutting from 1-8 in. to 6 in.

Four and Six Spindle's Vertical Nut Tappers.

CORRESPONDENCE SOLICITED.

HILL, CLARKE & CO.

42 OLIVER ST.,
Boston, Mass.

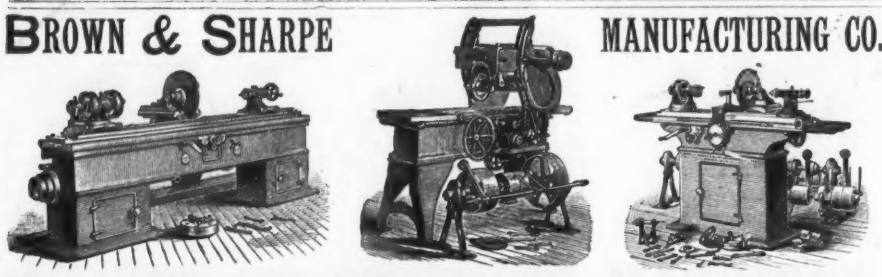
SEND FOR SPECIAL LIST.

New and Second-hand Machinery.

COLD-ROLLED SHAFTING, HANGERS, PULLEYS, ETC., ETC.

GEORGE PLACE MACHINERY CO.
121 Chambers St., New York.

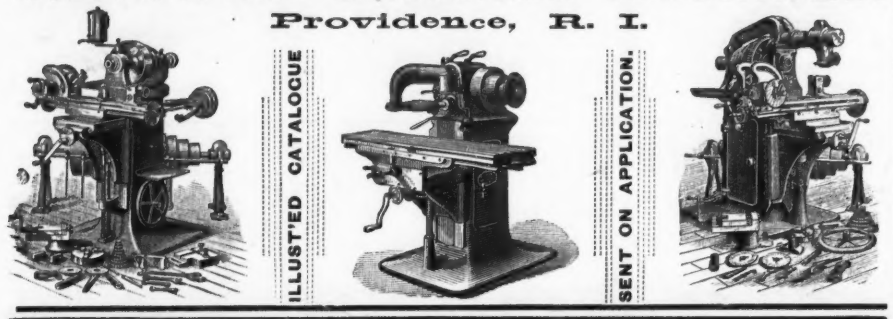
BROWN & SHARPE MANUFACTURING CO.



MILLING AND GRINDING MACHINES.

Providence, R. I.

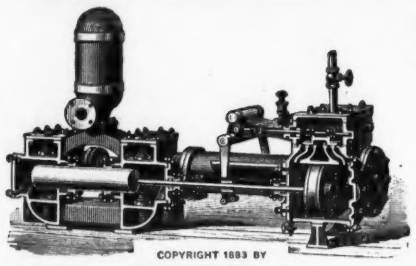
ILLUST'ED CATALOGUE SENT ON APPLICATION.



Duplex Steam Pumps

—AND—

WATER WORKS MACHINERY.



COPYRIGHT 1883 BY THE GORDON & MAXWELL CO.

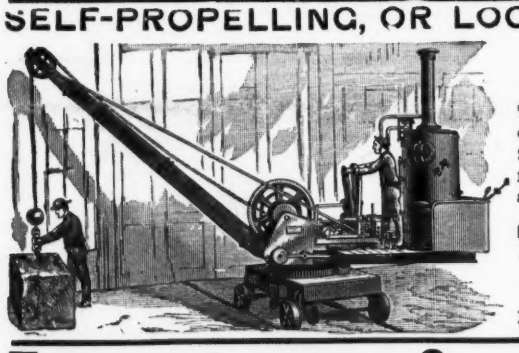
THE GORDON & MAXWELL CO.

HAMILTON, OHIO.

BRANCH HOUSES:

NEW YORK, 96 Liberty Street.
PHILADELPHIA, 713 Chestnut Street.
CHICAGO, 96 Lake Street.

SELF-PROPELLING, OR LOCOMOTIVE CRANES.



HOIST, ROTATE AND TRAVEL UNDER THEIR OWN STEAM.

The most generally useful Crane for shops, contractors, steel mills, etc. All capacities, 2 and 5-ton sizes usually in stock. Send for particulars and illustrated catalogue of all types of cranes.

The Yale & Towne Mfg. Co.,

STAMFORD, CONN.

New York, Chicago, Philadelphia, Boston.

ENGINE LATHES, SHAPERS & DRILLS.

20-INCH LEVER DRILL. 26-INCH BACK GEARED AND POWER FEED DRILL.

26 in. Upright Drill.
24 " " "
26 " Back Geared.
30 " and
38 " Power Feed Drills.

LODGE, DAVIS & CO.

CINCINNATI, OHIO.

Send For Prices. It Will Pay You.

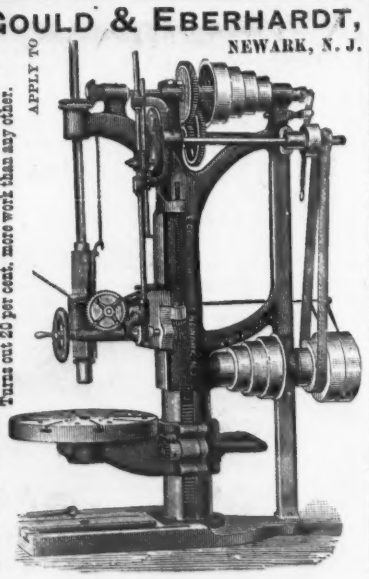
E. GOULD & EBERHARDT,

NEWARK, N. J.

Eberhardt's New Drill

Turns out 20 per cent. more work than any other.

APPLY TO

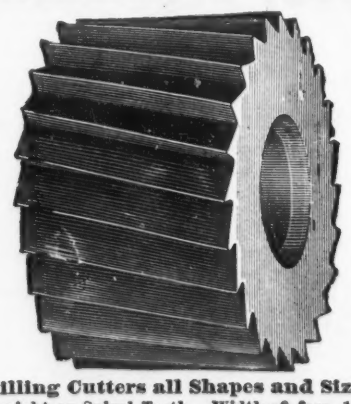


E. E. GARVIN & CO.

139 & 141 Centre Street, N. Y.,

MANUFACTURERS OF

MACHINISTS' TOOLS



Milling Cutters all Shapes and Sizes.

Straight or Spiral Teeth. Width of face, 1-8 in. to 3 in. Diameter, from 2 1-4 in. to 2 3-4 in.

SEND FOR CATALOGUE.

THE PRATT & WHITNEY CO.

HARTFORD, CONN.

Manufacture and have ready for delivery, TURRET HEAD MACHINES of 10, 12, 14, and 16 in. swing, with or without cut-off rest, suitable for finishing brass and other metals that do not require a free use of oil in cutting them. Prices are less than for screw machines, and will be given on application. The CUSHMAN PATENT COMBINATION LATHE CHUCKS are made stronger than formerly, have jaws ground true, and are offered at 35 per cent. discount from list.

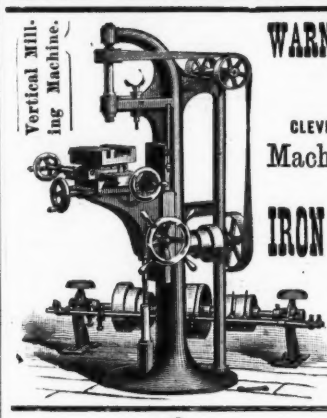
The Billings & Spencer Co., Hartford, Ct.

MANUFACTURERS OF

DROP FORGINGS IN COPPER, IRON OR STEEL.

Pure Copper Commutator Bars for Electric Motors or Generators, Steel Commutator Rings and Nuts, Steel Wrenches and Eye Bolts.

DROP FORGINGS FROM PURE COPPER.
THE BILLINGS & SPENCER CO. HARTFORD, CONN.



Vertical Milling Machine.

WARNER & SWASEY,

CLEVELAND, OHIO.

Machine Tools FOR **IRON & BRASS WORK.**

Send for Illustrated Catalogue.

Engine Lathes, Planers, Drills, &c.

POND MACHINE TOOL CO., SUCCESSORS TO DAVID W. POND,

New Designs, Quick Delivery. Great Variety. Worcester, Mass.

GEO. W. FIFIELD,

MANUFACTURER OF

ENGINE LATHES

FROM 16 to 48 IN. SWING.

Cuts, Photographs and Prices furnished on application.

Lowell, Mass., U. S. A.

GEAR WHEELS & GEAR CUTTING.

Send for Catalogue D.

GEORGE B. GRANT,

666 Beverly Street, Boston.

KEY SEATING MACHINES

AND

20 in. Drills a specialty.

Our 20 in. Drill is a heavy substantial tool, made for service, has steel shafts and spindle. Gears and racks cut from the solid and have all modern improvements, are made by special machinery, and sold very low.

Our Key Seating Machine will save enough in 60 days' use to pay first cost; no shop can afford to do without one. We have now ready for prompt shipment, both Key Seat Machines and 20 in. Drills. Send for Photo. and Catalogue.

W. P. DAVIS, North Bloomfield, N. Y.

HARTFORD STEAM BOILER INSPECTION AND INSURANCE CO.

HARTFORD, CONN.

J. M. ALLEN, President.
W. B. FRANKLIN, Vice-President.
J. B. Pierce, Secretary.

Lathes, 17 in. 20 in.
Planers 24"x24' 30"x30'

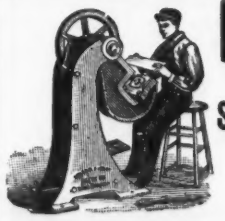
For New Reduced PRICE LIST, Write

THE G. A. GRAY CO.

SYCAMORE & WEBSTER Sts., Cincinnati, O

THE BUFFALO STEEL FOUNDRY, BUFFALO, N. Y.

ORDERS AND CORRESPONDENCE SOLICITED | PRATT & LETCHWORTH Proprietors.



PUNCHING PRESSES, DIES,

And other Tools for the Manufacture of all kinds of

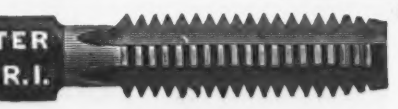
SHEET METAL GOODS, DROP FORGINGS, —ETC.— DROP HAMMERS.

STILES & PARKER PRESS CO.

MIDDLETOWN, CONN.

Branch Office and Factory 203, 205, and 207 CENTRE STREET, NEW YORK.

J. M. CARPENTER PAWTUCKET, R. I.



Manufacturer of TAPS AND DIES